

INSTRUCTION MANUAL

Serial Number _____

TYPE
140/R140
NTSC TEST SIGNAL
GENERATOR

Tektronix, Inc.

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1069



WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

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TABLE OF CONTENTS

SECTION 1	TYPE 140/R140 SPECIFICATION	page
	General Information	1-1
	NTSC Color Bars	1-1
	Modulated Staircase	1-1
	Vertical Interval Test Signals	1-1
	Sync Generator and Color Standards	1-2
	Convergence Pattern	1-2
	Electrical Characteristics	1-2
	Table 1-1	
	Staircase Signal Characteristics	1-2
	Table 1-2	
	Color Bar Characteristics	1-3
	Table 1-3	
	Sync Characteristics	1-5
	Table 1-4	
	Convergence Pattern Characteristics	1-6
	Table 1-5	
	Power Supply Characteristics	1-6
	Table 1-6	
	Physical Characteristics	1-7
	Environmental Characteristics	1-7
	Table 1-7	1-7
	Accessories	1-7
 SECTION 2	 OPERATING INSTRUCTIONS	
	Installation	
	Rackmounting	2-1
	Operating Voltage	2-1
	Basic Information	2-2
	Controls and Connectors	
	Introduction	2-4
	Front-Panel Controls	2-4
	Output Connectors	2-8
	Input Connectors	2-8
	Test Setup Chart	2-8

TABLE OF CONTENTS (cont)

First Time Operation	2-8
Procedure 1	2-8
Procedure 2	2-12
Procedure 3	2-15
Glossary of Terms	2-17

SECTION 3 CIRCUIT DESCRIPTION

Introduction	3-1
Generating Output Signals	3-1
Generating Modulated Staircase	
Chrominance	3-3
Luminance	3-6
Generating Color Bar	
Color Bar Chrominance	3-6
Color Bar Luminance	3-6
Split Field Chrominance	3-7
Split Field Luminance	3-7
Integrated Circuits	3-7
Micrologic Unit Configurations	
F μ L 914	3-7
F μ L 923	3-12
Subcarrier Oscillator & Output	
Subcarrier Oscillator	3-13
Master Oscillator Oven	3-13
Oven Temperature Lamp	3-13
Subcarrier and Sync Source Switching	
Subcarrier Source Switching	3-15
Ext Sync Processing	3-15
Goniometer Drive and Subcarrier	3-15
Output Amplifier	3-15
Chrominance Enable	3-17
Line Timing	
Phase Lock Sampler	3-17
DC Control Loop Amplifier	3-17
Line Frequency Control Oscillator	3-18
Line Counter	3-18

TABLE OF CONTENTS (cont)

Bar Osc Start and Bar Preset	3-19
Horiz Drive Gate	3-19
Comp Sync Logic	3-19
Burst Logic	3-19
Field Preset Gate	3-19
Line Detail Timing	3-19
Field Timing	3-19
Field Counter	3-20
Field Logic	3-20
VITS Logic	3-20
Video Logic	3-22
APL Logic	3-22
Bar Timing	
Bar Oscillator	3-22
Bar Oscillator Frequency Control	3-24
÷ By 4 Counter	3-24
Bar Oscillator Start-Stop Control	3-24
Luminance Delay	3-24
Color Bar Chroma Counter & Logic	3-24
Color Bar Luminance Counter & Logic	3-24
IQ White Drive	3-24
Color Bar Setup & Line Blanking	3-26
IQ Chrominance Logic	3-26
IQ Chrominance Amplitude	3-26
Color Bar and Setup Voltage Supplies	3-26
Staircase	
Staircase Timing Logic	3-26
Staircase Luminance Amplitude	3-26
APL Amplitude	3-28
Staircase Chroma Amplitude	3-28
APL Chroma	3-28
Comp Sync Amplitude	3-28
Color Bar Drive	
Color Bar Chroma Amplitude	3-30
Burst Amplitude	3-30
Modulator	
Subcarrier Limiter & Modulator Driver	3-30
0-180° Phase Shifter	3-31

TABLE OF CONTENTS (cont)

(R-Y) (B-Y) Quad Phase	3-31
\pm (B-Y) and \pm (R-Y) Filters	3-31
R-Y and B-Y Double Balanced Modulators	3-31
Bandpass Filter	3-32
Video Out	3-32
Color Bar Luminance Amplitude	3-32
I, Q White Reference Amplitude	3-33
Wide Band Filter	3-33
Narrow Band Filter	3-33
Luminance Output Filter	3-33
Chrominance Enable	3-33
Chrominance Output Amplifier	3-33
Output Amplifiers	3-34
Comp Blanking Output Amp	3-34
Crosshatch and Dot Generator	3-34
Horizontal Timing Generator	3-34
Field Timing Generator	3-35
Output Amplifier	3-37
Low Voltage Power Supply	3-37
Power Input	3-37
-15 Volt Supply	3-40
+3.6 Volt Supply	3-40
+10 Volt Supply	3-42

SECTION 4 MAINTENANCE

Introduction	4-1
Preventive Maintenance	
General	4-1
Cleaning	4-1
Exterior	4-1
Interior	4-1
Lubrication	4-1
Visual Inspection	4-1
Transistor and Integrated Circuit Checks	4-1
Recalibration	4-1

TABLE OF CONTENTS (cont)

Corrective Maintenance	
General	4-2
Ordering Replacement Parts	
Standard Parts	4-2
Special Parts	4-2
Ordering Parts	4-2
Soldering Techniques	
Circuit Boards	4-2
Metal Terminals	4-3
Component Replacement	
Interconnecting Wires	
Removal	4-3
Replacement	4-3
Circuit Boards	
Removal	4-4
Replacement	4-4
Transistors and Integrated Circuit Replacement	4-4
Indicator Lamp Replacement	4-6
Fuse Replacement	4-6
Switches	4-6
Power Transformer Replacement	4-6
Troubleshooting	
Introduction	4-6
Troubleshooting Aids	
Diagrams	4-6
Switch Wafer Identification	4-7
Circuit Boards	4-7
Wire Color Codes	4-7
Resistor Color Codes	4-7
Capacitor Markings	4-7
Diode Color Code	4-7
Transistor and IC Lead Configuration	4-7
Troubleshooting Equipment	4-7
Troubleshooting Techniques	4-8

TABLE OF CONTENTS (cont)

SECTION 5 PERFORMANCE CHECK/CALIBRATION

Introduction	5-1
Test Equipment Required	5-1
General	5-1
Equipment List	5-1
Calibration Record and Index	5-2
Short Form Calibration Procedure	5-2
Performance Check/Calibration Procedure	
General	5-4
Preliminary Procedure	5-5
Procedure	5-6

SECTION 6 RACKMOUNTING

Rackmounting Instructions	
Mounting Methods	6-1
Instrument Dimension	6-1
Rackmounting in a Cabinet Rack	
General Information	6-1
Mounting Procedure	6-1
Adjustments	6-2
Maintenance	6-2

SECTION 7 ELECTRICAL PARTS LIST

Abbreviations and Symbols	
Parts Ordering Information	
Index of Electrical Parts List	
Electrical Parts List	

TABLE OF CONTENTS (cont)

SECTION 8 DIAGRAMS AND MECHANICAL PARTS ILLUSTRATIONS

Diagrams
Mechanical Parts Illustrations

SECTION 9 MECHANICAL PARTS LIST

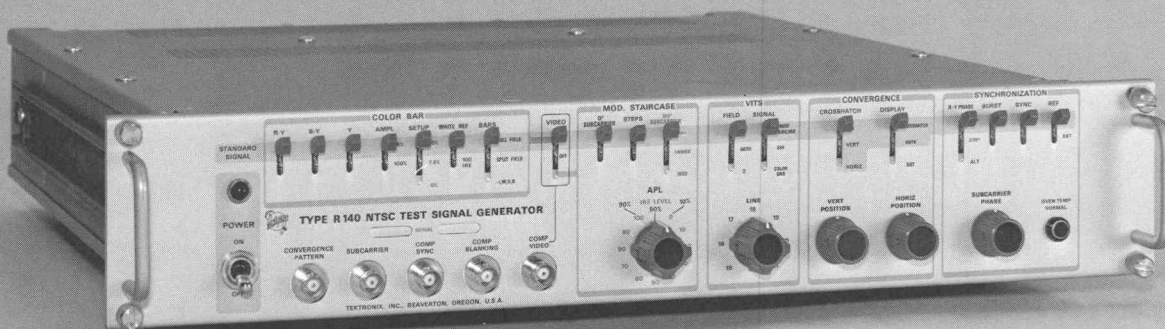
Mechanical Parts List Information
Index of Mechanical Parts Illustrations
Mechanical Parts List
Accessories

CHANGE INFORMATION

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.



(A) The Type 140 NTSC Test Signal Generator (bench model).



(B) The Type R140 NTSC Test Signal Generator (rackmount model).

Fig. 1-1. The two models of the generator are electrically identical.

SECTION 1

TYPE 140/R140 SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

General Information

The Tektronix Types 140 and R140 NTSC¹ Test Signal Generators² are a compact, solid-state source of high-quality television test signals for 525-line, 60 Hz field standard NTSC color TV systems. Combined in one compact unit are the test signals needed to accurately test, evaluate, and adjust laboratory and standard broadcast color video equipment. Each test signal not only strictly adheres to industry standards, but also provides additional refinements to enhance the accuracy and range of measurements which can be made. The self-contained sync generator includes a temperature controlled color standard with excellent frequency stability. Digital integrated circuits are extensively used to achieve stability, accuracy, and reliability.

Three operating modes provide NTSC color bars, 5 step staircase with APL³ and a 5 step staircase with variable APL. A convergence pattern signal is available independent of and separate from other test signals.

NTSC Color Bars. NTSC color bars in descending luminance order in either full field or split field are provided by the Type R140. The composition of these signals is in accord with EIA color bar signal specification RS-189. In addition to basic signal requirements, these 100% saturated color bars are provided in either 75% or 100% amplitude with a choice of setup level. The white bar amplitude, which precedes the yellow bar, may be selected at 75% or 100% for 75% amplitude bars. The 100% white bar amplitude level permits a convenient check of relative chrominance/luminance gain by comparing the peak amplitudes of the yellow, cyan, and white bars. An additional refinement to the full field color bar is a black reference bar following the blue bar.

Modulated Staircase. The modulated staircase signal is provided with a choice of variable APL from 10% to 90% (0

to 100 IRE) in ten equal increments (11 levels), or a fixed APL of 50%.

The staircase luminance component consists of five 20 IRE-unit risers. The subcarrier component is phase-locked to color burst. The signal is in strict conformity with IRE Standard 60-23.S1 and the definition of APL is rigorously observed. Applications include measurements of differential gain and phase, dynamic gain, luminance signal linearity, and luminance signal distortion caused by chrominance signal non-linearity and burst phase errors.

A new signal capability provides a means to check luminance signal distortion caused by rectification of the subcarrier signal. When the variable APL mode is selected, an additional component consisting of subcarrier, phased to lead burst by 90°, may be added to the low-frequency lines either as a constant 30 mV amplitude signal or it may be amplitude-modulated to produce 30 mV, 305 mV, and 610 mV amplitudes. The modulated subcarrier signal position is useful for determining the effects of subcarrier rectification upon luminance signals at all APL's through the entire TV system. The constant 30 mV amplitude subcarrier signal is useful for eliminating unnecessary portions of the display when making differential phase measurements.

Vertical Interval Test Signals. Provision is made for insertion of either the staircase or the color bar, as a vertical interval test signal, on any line from 15 through 21 of either or both fields. The phase of the burst (and all other subcarrier frequency components of the test signal outputs) may be varied 360° with respect to the subcarrier frequency source (internal or external).

With the 75% amplitude full field color bar signal or the modulated staircase signal inserted on an appropriate line of both fields, it is possible to test an entire video system including transmitters for differential phase and gain. This method also provides for checking whether the actual phase and amplitude errors of the chrominance at all APL's conforms to FCC rules.

¹ National Television System Committee.

² Since the two models of the generator are electrically identical, the rackmount model (Type R140) is used for the text and illustrations in this manual unless noted otherwise.

³ Average Picture Level.

Sync Generator and Color Standards. The EIA sync generator circuitry is largely digital, using integrated circuit counting functions. The usual frequency multiplier circuits and their attendant problems have been avoided, resulting in exceptional time stability. Internal controls permit some variation of widths including burst flag timing. These adjustments are preset to conform to FCC standards.

The color standard has a proportional control oven for the quartz crystal and the entire oscillator circuit. The frequency stability achieved is well within FCC specifications. A front-panel lamp indicates proper operation of the oven. When the internal color standard is used, the phase of the color subcarrier output is variable over a 360° range with respect to the phase of the burst contained in the video output. When an external color standard is used the phase of the burst (and all other subcarrier frequency components of the test signal outputs) may be varied 360° to the external subcarrier source.

Convergence Pattern. The convergence pattern signal is provided separately and independently from the other test signals. It is useful for measuring picture monitor or camera scanning linearity, aspect ratio and geometric distortion. It conforms to IRE Standard 54-23.S1. Displays available include crosshatch, vertical lines only, horizontal lines only, dots only, and crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern).

ELECTRICAL CHARACTERISTICS

The following performance requirements apply over an ambient temperature range of 0°C to $+50^\circ\text{C}$, after a warm-up time of 10 minutes. A 20-minute warmup is required for rated accuracies at 0°C ambient temperature.

TABLE 1-1

STAIRCASE SIGNAL ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Luminance Component	
Step Amplitude	143 mV within 1%.
5 Step Amplitude	714 mV within 1%.
Step Risetime	260 ns within 15%.
Aberrations	Within 2% of step amplitude.

Characteristics	Performance Requirement
Step Duration	
Blanking Level	13.2 μs within 5%.
White Level	13.2 μs within 5%.
Intermediate Level	6.6 μs within 5%.
Chrominance Component	
Amplitude	143 mV within 3%.
Differential Phase	
10% APL	0.1° or less.
50% APL	0.1° or less.
90% APL	0.1° or less.
Differential Gain	
10% APL	0.5% or less.
50% APL	0.5% or less.
90% APL	0.5% or less.
Subcarrier Envelope	
Risetime	375 ns within 15%.
Duration	40 μs within 5%.
Envelope Delay from Horizontal Sync	16.1 μs within 5%
APL	APL specifications conform to IRE Standard 60-23.S1.
Fixed	All active lines carry the modulated staircase signal with APL fixed at 50%.
Selectable	Staircase signal is on every fifth line, and the same line each frame. The IRE level of the other four lines can be selected from 0 IRE (10% APL) to 100 IRE (90% APL) in ten equal increments, equal within 2%.
Subcarrier Component	
Off	No subcarrier.

Characteristic	Performance Requirement
Unmod	30 mV within 1.5 mV (approximately 5 IRE units at 90°) during active line time of 52.3 μ s.
Modulated Subcarrier	30 mV within 1.5 mV for the first and last 13.2 μ s of active line time.
	305 mV within 3% (43 IRE units) for the second 13.2 μ s of active line time corresponding to 75% amplitude chrominance, red and cyan color bars.
	610 mV within 3% (86 IRE units) for the third 13.2 μ s of active line time corresponding to 75% amplitude chrominance, red and cyan color bars phased at 90°.
	Incidental phase errors between 30 mV, 305 mV, and 610 mV signals, 0.5° or less.

TABLE 1-2

COLOR BAR ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Timing	
Full Field Bars	241.5 lines per field.
Bar Duration	6.6 μ s (8 bars).
Risetime (White Bar)	115 ns within 15%.
Split Field Color Bar	181 lines for field 1. 181.5 lines for field 2.
Bar Duration	7.5 μ s/bar (7 bars).
—I, W, Q, B	60.5 lines for field 1. 60 lines for field 2.
—I, W, Q Duration	9.4 μ s
Black Duration	24.1 μ s

Characteristic	Performance Requirement
Full Field —I, W, Q, B	241.5 lines/field.
—I, W, Q Duration	9.4 μ s
Black Duration	24.1 μ s
Chrominance Time Difference between Luminance and Chrominance	20 ns or less.
Risetime	375 ns within 15%.
B-Y, R-Y Quadrature Error	0.5° or less.
R-Y Axis Phase Switcher	0.5° or less.
Residual Subcarrier	At least 52 dB below 1 V on White, Black.
Aberrations	Within 4% peak to peak of 1 V.
Spurious Subcarrier	At least 52 dB below 1 V when viewed on a Type 529/RM529, except 30 dB during sync and at the end of H blanking.
Other Spurious Subcarrier	At least 52 dB below 1 V when viewed on a Type 529/RM529, except 30 dB during sync and at the end of H Blanking.
Comp Video Return Loss	At least 30 dB.
Isolation	At least 40 dB.
Front Porch	1.54 μ s within 0.05 μ s measured at 10% from blanking.
Luminance and Chrominance Accuracy	Absolute amplitudes of luminance signal, setup and sync are within 1% or 1.5 mV, whichever is greater, with respect to blanking.
	Absolute amplitudes of all subcarrier frequency components

Characteristic	Performance Requirement			
Blanking Level	(Chrominance R-Y, B-Y) are within 3%.			
	Relative amplitudes of all subcarrier frequency components are within 1% or 1.5 mV, whichever is greater, of the red chrominance bar.			
	REFERENCE AMPLITUDES (mV, P-P)			
	Lumi-nance	Chromi-nance	B-Y	R-Y
	0	2.5 mV or less	----	----
Sync	285.7	2.5 mV or less	----	----
Burst	0	285.7	285.7	0
—I	⁴ ---	285.7	155.6	239.6
White Ref	714.3	2.5 mV or less	----	----
Q	⁴ ---	285.7	239.6	155.6
Black	⁴ ---	2.5 mV or less	----	----
(75% AMPLITUDE 10% SETUP)				
White	553.6	2.5 mV or less	----	----
Yellow	500.5	433.0	422.9	93.0
Cyan	408.9	609.0	142.6	592.1
Green	355.9	572.4	280.4	499.1
Magenta	269.1	572.4	280.4	499.1
Red	216.1	609.0	142.6	592.1
Blue	124.5	433.0	422.9	93.0
Black	71.4	2.5 mV or less	----	----
(75% AMPLITUDE, 7.5% SETUP)				
White	549.1	2.5 mV or less	----	----
Yellow	494.6	445.1	434.7	95.6
Cyan	400.4	625.9	146.5	608.5
Green	345.9	588.3	288.2	512.9
Magenta	256.7	588.3	288.2	512.9
Red	202.2	625.9	146.5	608.5
Blue	108.1	445.1	434.7	95.6
Black	53.6	2.5 mV or less	----	----

⁴ Same as color bar BLACK level (determined by setup).

	REFERENCE AMPLITUDES (mV, P-P)			
	Lumi-nance	Chromi-nance	B-Y	R-Y
(75% AMPLITUDE, 0% SETUP)				
White	535.7	2.5 mV or less	----	----
Yellow	476.8	481.2	469.9	103.4
Cyan	375.0	676.7	158.4	657.9
Green	316.1	636.0	311.5	554.5
Magenta	219.6	636.0	311.5	554.5
Red	160.7	676.7	158.4	657.9
Blue	58.9	481.2	469.9	103.4
Black	0	2.5 mV or less	----	----
(100% AMPLITUDE, 10% SETUP)				
White	714.3	2.5 mV or less	----	----
Yellow	643.6	577.4	563.9	124.1
Cyan	521.4	812.0	190.1	789.5
Green	450.7	763.2	373.8	665.4
Magenta	335.0	763.2	373.8	665.4
Red	264.3	812.0	190.1	789.5
Blue	142.1	577.4	563.9	124.1
Black	71.4	2.5 mV or less	----	----
(100% AMPLITUDE, 7.5% SETUP)				
White	714.3	2.5 mV or less	----	----
Yellow	641.6	593.4	579.6	127.5
Cyan	516.1	834.6	195.4	811.4
Green	443.4	784.4	384.2	683.9
Magenta	324.5	784.4	384.2	683.9
Red	251.8	834.6	195.4	811.4
Blue	126.3	593.4	579.6	127.5
Black	53.6	2.5 mV or less	----	----
(100% AMPLITUDE, 0% SETUP)				
White	714.3	2.5 mV or less	----	----
Yellow	635.7	641.6	626.6	137.8
Cyan	500.0	902.3	211.2	877.2
Green	421.4	848.0	415.4	739.3
Magenta	292.9	848.0	415.4	739.3

	REFERENCE AMPLITUDES (mV, P-P)			
	Lumi- nance	Chromi- nance	B-Y	R-Y
Red	214.3	902.3	211.2	877.2
Blue	78.6	641.6	626.6	137.8
Black	0	2.5 mV or less	----	----

TABLE 1-3
SYNC ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
COMP SYNC	
Output	
Amplitude	4 volts within 0.2 volt into 75 ohm.
Return Loss	At least 30 dB to 5 MHz.
Isolation	At least 40 dB.
Rise- and Fall- time	115 ns within 10%.
Jitter	4 ns peak to peak or less.
Line Sync Duration	4.71 μ s within 0.05 μ s measured at 10% from blanking level.
Line Period	63.56 μ s ⁵
Equalizing Pulse	
Duration	2.33 μ s within 0.05 μ s measured at 10% from blanking level.
Sequence Duration	
First	3 lines ⁵
Second	3 lines ⁵
Field Sync Pulse	
Duration	27.3 μ s within 0.2 μ s measured at 10% from blanking level.
Sequence Duration	3 lines ⁵
Interval be- tween pulses	4.5 μ s within 0.2 μ s measured at 10% from blanking level.
Field Period	262.5 lines ⁵

Characteristic	Performance Requirement
Input (Loop-thru)	
Amplitude	2 volts to 8 volts, negative polarity.
Return Loss	At least 46 dB.
SUBCARRIER	
Output	
Amplitude	2 volts within 0.2 volt into 75 ohm.
Frequency	3.579545 MHz within 5 Hz.
Return Loss	At least 30 dB.
Isolation	At least 30 dB.
Input (Loop-thru)	
Amplitude	1 volt to 4 volts.
Return Loss	At least 46 dB at 3.58 MHz.
HORIZ DRIVE	
Amplitude	4 volts within 0.2 volt into 75 ohm.
Pulse Duration	6.35 μ s within 5%.
Rise- and Falltime	115 ns within 10%.
Return Loss	At least 30 dB.
VERT DRIVE	
Amplitude	4 volts within 0.2 volt into 75 ohm.
Pulse Duration	10.5 lines ⁵
Rise- and Falltime	115 ns within 10%.
Return Loss	At least 30 dB.
COMP BLANKING	
Amplitude	4 volts within 0.2 volt into 75 ohm.
Duration	
Line Blanking	11.1 μ s ⁵
Field Blanking	21 lines ⁵
Rise- and Falltime	115 ns within 10%.

⁵ Digitally determined from 3.579545 MHz.

Characteristic	Performance Requirement
Return Loss	At least 30 dB.
Isolation	At least 40 dB.
BURST FLAG	
Amplitude	4 volts within 0.2 volt into 75 ohm.
Duration	2.3 μ s within 5%.
Rise- and Falltime	115 ns within 10%.
Delay from H Sync	5 μ s within 5%.
Return Loss	At least 30 dB.
BURST	
Breezeway	At least 379 ns.
Risetime	375 ns within 15%.
Envelope Duration	2.22 μ s to 2.61 μ s.
Time Duration from leading edge of Sync Pulse to trailing edge of Burst Envelope	7.94 μ s or less at 10% from blanking level.
Burst Amplitude	2.86 mV within 3%.

TABLE 1-4

CONVERGENCE PATTERN SIGNAL ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
CONVERGENCE PATTERN	
Setup	72 mV within 5%.
Sync Amplitude	286 mV within 5%.
Pulse Amplitude	714 mV within 5%.
Amplitude (overall)	1 volt peak to peak within 5%.
Return Loss	At least 30 dB.
Isolation	At least 40 dB.
Risetime	115 ns within 10%.

Characteristic	Performance Requirement
Crosshatch Vertical Lines	
Repetition Rate	315 kHz.
Pulse Time Position Range	At least 3.2 μ s.
Pulse Polarity	Positive
Number of Unblanked Pulses	16 or 17 depending on POSITION control.
Crosshatch Pulse Duration	225 ns within 15%.
Dot Pulse Duration	350 ns within 15%.
Crosshatch Horizontal Lines	
Repetition Rate	900 Hz ⁶
Pulse Time Position Range	At least 1.1 ms.
Pulse Polarity	Positive
Number of Unblanked Pulses	13 to 14 depending on POSITION control.
Crosshatch Pulse Duration	1 line at field rate ⁶ .
Dot Pulse Duration	3 lines per frame ⁶ .
Displays Available	Crosshatch. Vertical Lines only. Horizontal Lines only. Dots. Crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern).

⁶Digitally determined from 3.579545 MHz.

TABLE 1-5

POWER SUPPLY ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Power Connection	The instrument is provided with a

Characteristic	Performance Requirement
	three-wire power cord with a three-terminal polarized plug for connection to the power source. The third wire is directly connected to the instrument to protect operating personnel as recommended by national and international safety codes.
Line Voltage Range	
115 VAC Low	90 V to 110 V.
115 VAC Medium	104 V to 126 V.
115 VAC High	112 V to 136 V.
Crest Factor	1.35
230 VAC Low	180 V to 220 V.
230 VAC Medium	208 V to 252 V.
230 VAC High	224 V to 272 V.
Crest Factor	1.35
Line Frequency Range	48 Hz to 66 Hz.
Line Current	0.5 A Maximum.
Power	55 W Maximum until OVEN TEMP NORMAL indicator is on.

TABLE 1-6

PHYSICAL CHARACTERISTICS

Characteristic	Information
Finish	Cabinet is blue-vinyl paint. Front-panel is anodized aluminum.
Dimensions	
Cabinet Model (overall)	
Height	3.82 inches.
Length	19.10 inches.
Width	17.85 inches.

Characteristic	Performance Requirement
Rackmount Model (overall)	
Height	3.47 inches.
Length	19.66 inches.
Width	19.00 inches.

ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

TABLE 1-7

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Information
Temperature	
Non-Operating Range	−40°C to +65°C.
Operating Range	0°C to +50°C.
Altitude	
Non-Operating Range	To 50,000 feet.
Operating Range	To 15,000 feet.

ACCESSORIES

Standard accessories supplied with this instrument can be found on the last page of the Mechanical Parts List illustrations. For additional accessories, see the current Tektronix, Inc. catalog.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is a vertical crease down the center, suggesting it's a notebook page. The paper is otherwise blank, with no handwriting or other markings.

SECTION 2

OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

INSTALLATION

Rackmounting

Complete information for mounting the Type R140 in a rack is given in Section 6.

Operating Voltage

The Type R140 may be operated from either a 115-V or 230-V line voltage source. Quick-change line-voltage selector plugs, located under the fuse cover on the rear panel, change the transformer primary connections so that the instrument can operate from one line voltage or the other (115 V or 230 V). In addition, the plugs permit one of three line voltage operating ranges to be selected. Table 2-1 lists all the voltage ranges that enable the instrument DC power supplies to regulate properly.

To convert to a different line voltage, proceed as follows:

1. Disconnect the Type R140 from the power source.

TABLE 2-1

115/230 Voltage Selector Plug Position	Range Selector Plug Position	Nominal Line (center) Voltage	Line Voltage Operating Range ¹
115 V	LO (Low)	100 VAC	90 to 110 VAC
	M (Medium)	115 VAC	104 to 126 VAC
	HI (High)	124 VAC	112 to 136 VAC
230 V	LO (Low)	200 VAC	180 to 220 VAC
	M (Medium)	230 VAC	208 to 252 VAC
	HI (High)	248 VAC	224 to 272 VAC

¹ Applicable when the line contains less than 2% total distortion.

2. Unscrew the two captive screws holding the fuse cover. Remove the cover and attached fuses.

3. To convert to a different line voltage (115 V to 230 V), pull out the 115/230 Voltage Selector plug (see Fig. 2-1). Rotate the plug 180° and insert it into the opposite set of holes. The 115/230 Voltage Selector plug is located in the upper position for 115-V operation and in the lower position for 230-V operation.

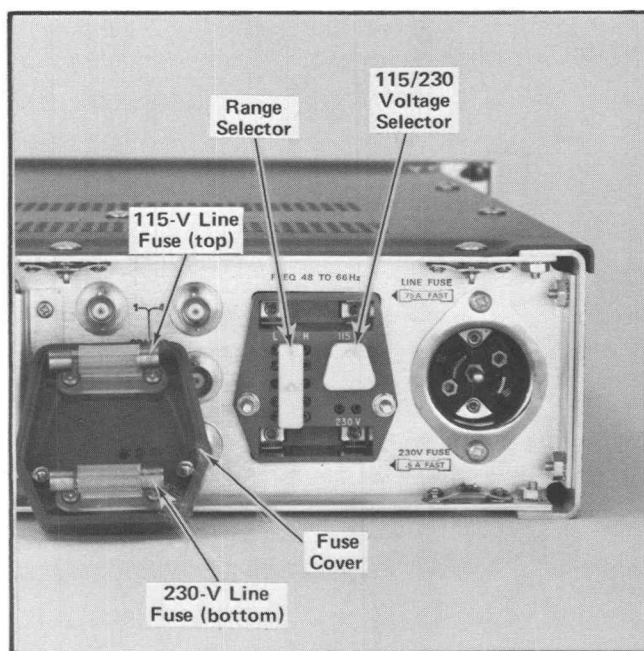


Fig. 2-1. Location of Range and Voltage Selector plugs with fuse cover removed. The plugs as shown are set for 115-V medium range operation.

4. To change the line-voltage operating range (LO, M or HI), pull out the Range Selector plug (see Fig. 2-1) and insert it in the desired hole locations. Select a range with a center voltage (see column 3 in Table 2-1) closely corresponding to the line voltage that will be applied in regular instrument operation.

5. Re-install the cover with two captive screws and fuses. Be sure the cover fits firmly against the rear panel. This indicates that the line fuses are seated properly in fuse clips.

6. Before applying power to the instrument, check that the indicating tabs on the selector plugs protrude through

the proper holes in the cover for the correct line voltage and the proper operating range.

CAUTION

The Type R140 should not be operated with the 115/230 Voltage Selector and/or Range Selector plugs in the wrong position for the line voltage applied. Operation of the instrument with either plug in the wrong position may cause incorrect operation or damage to the instrument.

BASIC INFORMATION

Frequent check-out of color broadcast equipment is essential in providing realistic and accurate presentation of taped or live color scenes. In addition, rapid check-out of the signal monitoring instruments is highly desirable.

Type R140 provides a high-quality composite video signal complete with color components, suitable for checking calibration and operation of vectorscopes and TV waveform monitors.

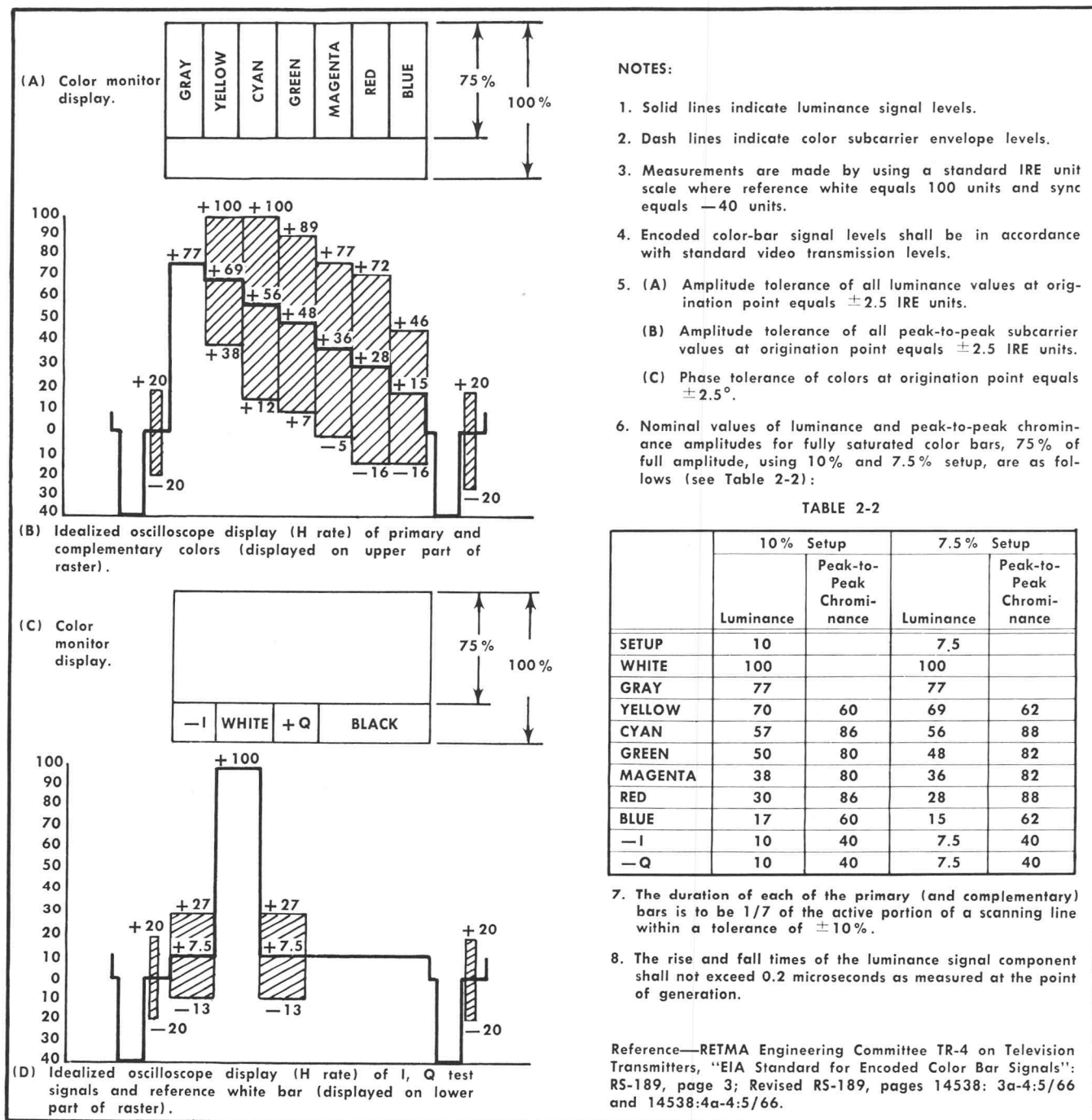


Fig. 2-2. Illustrations with notes showing the characteristics of a split field color bar signal using a 7.5% setup. Table 2-2 compares the amplitude of the color bars for 10% and 7.5% setup.

The various components which comprise the composite color video signal can be added or removed from the composite signal by front-panel operational controls on the Type R140. This permits the simulation of various broadcast equipment troubles, such as loss of sync signals, B-Y or R-Y components, etc.

The Type R140 also serves as an excellent teaching aid, since the composite video signal can be "built up", one component at a time. Also, both the familiar staircase and color bar test signals are available as part of the composite video signal.

Fig. 2-2 illustrates the split field color bar test signal. This signal is useful for checking luminance, hue and saturation levels.

Luminance is brightness as perceived by the eye. This is represented by the amplitudes of the step levels of the color bar signal between black and white levels. Since the eye is more sensitive to green and less to blue light of equal energy, green is a bright color, blue is a dark color as conveyed by the luminance signal to monochrome TV receivers. The color bar steps are therefore arranged in de-

scending luminance order starting with yellow, the brightest color and ending with blue, the least bright color.

Chrominance consists of two additional quantities; hue and saturation. Hue is the attribute of color perception that determines whether the color is red, blue, green, or some other color. White, black and gray are not considered hues. In color TV systems, the hue is encoded as a phase angle of the signal with respect to a reference frequency (burst signal). See Fig. 2-3 (B).

Saturation is the degree to which a color (or hue) is diluted by white light. Percentage of saturation is used to distinguish between vivid and weak shades of the same hue. For example, vivid red is highly saturated and pink or pastel red has little saturation. One-hundred percent saturation represents full hue with no white dilution. In a vector display, saturation is indicated by the length of the vector. See Fig. 2-3 (A).

The full field color bar and modulated staircase test signals are illustrated in Fig. 2-4. The color bar test signal is useful for checking luminance, hue and saturation. Note that this signal differs from that of Fig. 2-2B in that color bars are shorter in duration and black is part of the normal signal. The staircase for NTSC normally consists of 5 steps

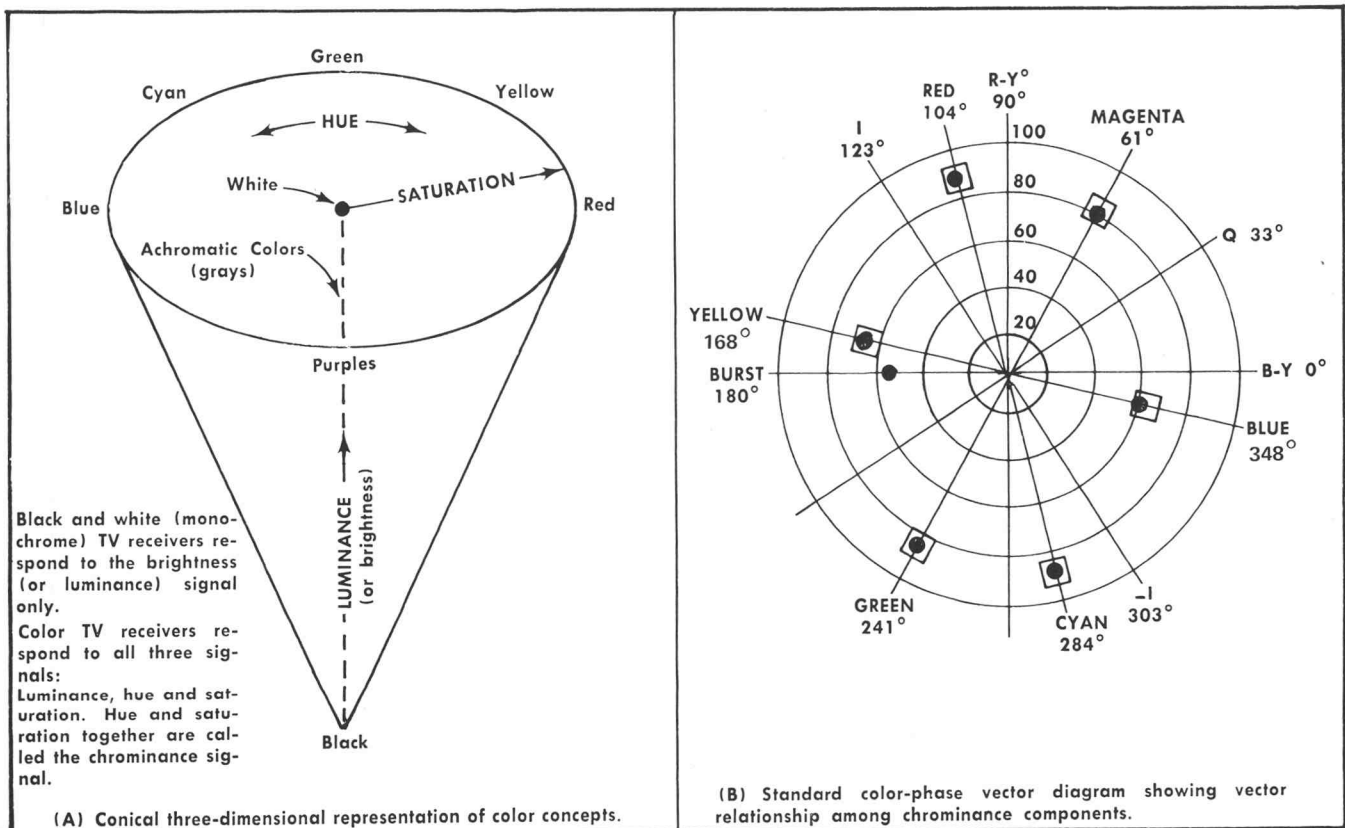


Fig. 2-3. Illustrations showing the relationship between the basic color concepts and the standard color-phase vector diagram.

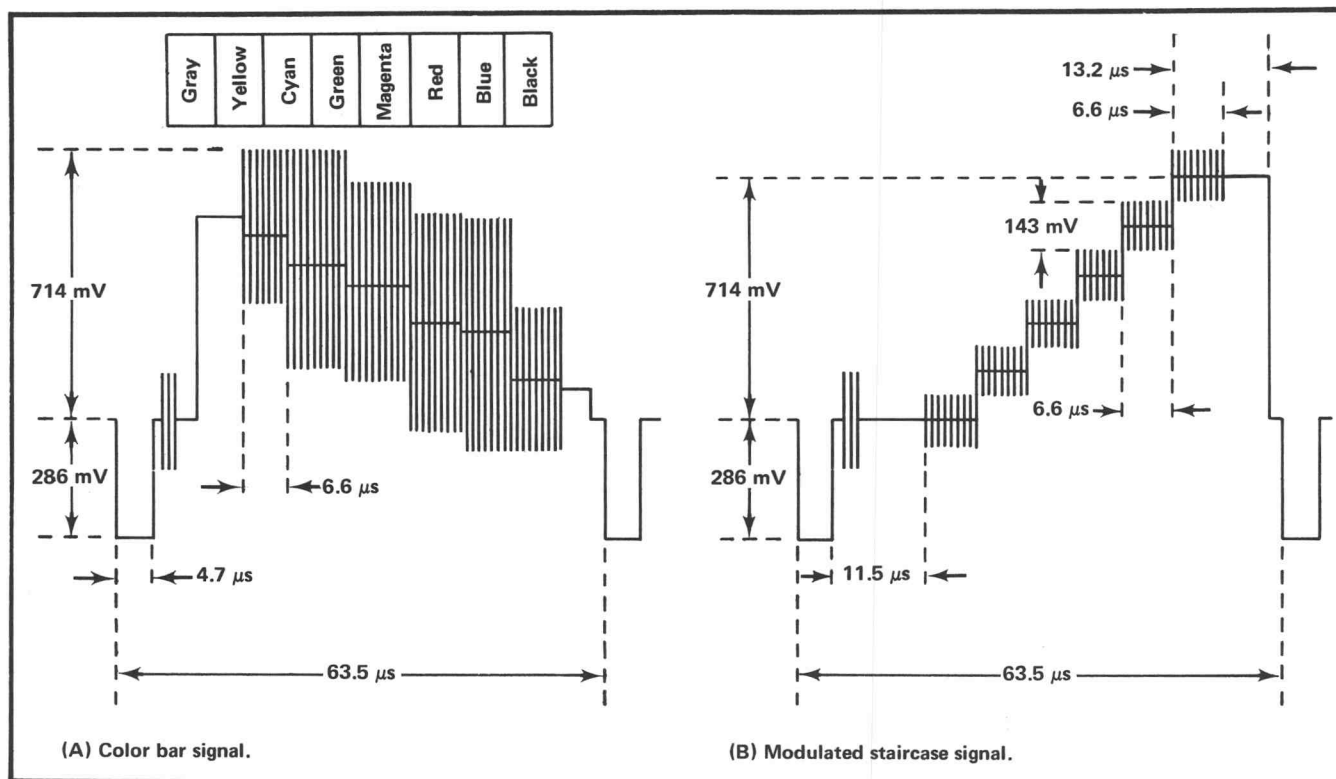


Fig. 2-4. Color bar and modulated staircase output signals.

(6 levels), each of which is modulated by the subcarrier frequency (3.579545 MHz). The steps are equally spaced between black level and white level. Staircase test signals are useful for checking presence of non-linearity in video stages. Typical tests made with a modulated staircase are differential gain and differential phase.

Differential gain is a change in color subcarrier amplitude as a function of luminance. In the reproduced color picture, presence of differential gain will cause distortion of the saturation in the areas between light and dark portions of the screen.

Differential phase is a phase modulation of the chrominance signal by the luminance signal. With differential phase present, color (hue) will vary with scene brightness in the reproduced color picture.

CONTROLS AND CONNECTORS

Introduction

A brief description of the function or operation of the Type R140 controls and front- and rear-panel output connectors is provided here (see Fig. 2-5).

Front-Panel Controls

COLOR BAR Consists of seven lever switches to control signal elements which make

up the standard color bar test signal.

R-Y Lever Switch:

Up position turns on the R-Y (90° – 270° axis) component of the color bar test signal. Down position turns off the R-Y component.

B-Y Lever Switch:

Up position turns on the B-Y (0° – 180° axis) component of color bar test signal. Down position turns off the B-Y component.

Y Lever Switch:

Up position turns on the luminance component of the color bar. Down position turns off the component.

AMPL Lever Switch:

The 75% position sets the amplitude of the color bar signal at 75%

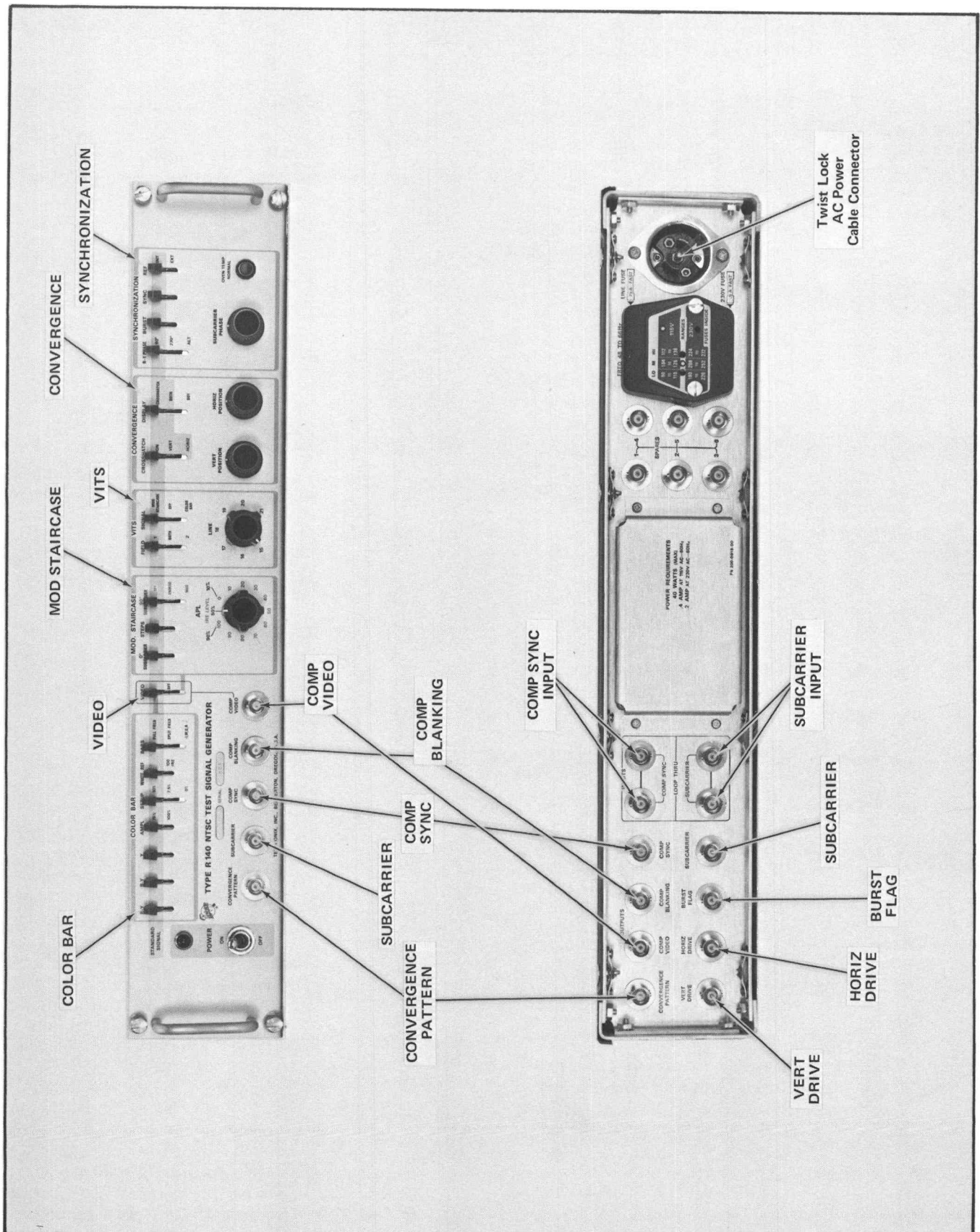


Fig. 2-5. Front- and rear-panel controls and connectors on the Type R140 NTSC Test Signal Generator.

of maximum amplitude. The 100% position sets the amplitude of the color bar signal at 100% amplitude.

SETUP Lever Switch:

The 10% position sets the black level at 10% of the 100% white reference level. The 7.5% position provides a setup of 7.5% of the white reference level. The 0% position removes the setup. In this position (0%) the black level is the same as the blanking level.

WHITE REF Lever Switch:

Affects white bar in full field bar mode only. Up position allows white bar amplitude to be determined by the AMPL and SETUP switches. The 100 IRE position sets the white reference at 100% amplitude (100 IRE).

BARS Lever Switch:

The FULL FIELD position puts a color bar signal on both fields. The SPLIT FIELD position provides a color bar signal for 11.5 ms followed by a -I, W, Q, B signal for 3.8 ms on both fields (in the SPLIT FIELD position, the width of each color bar is greater and there is no black level on the color bars). The -I, W, Q, B position provides a -I, W, Q, B signal.

VIDEO

Up position provides a color bar signal at the COMP VIDEO connectors. Center (OFF) position removes the video component from all the active video lines. When in down position a modulated staircase signal is provided at the COMP VIDEO connectors.

MOD STAIRCASE

Consists of three lever switches and a twelve-position rotary switch to control the individual components of the staircase test signal.

0° SUBCARRIER Lever Switch:

Up position applies a 143 mV subcarrier at 0° with respect to burst

(180°) to the staircase test signal. Down position removes the subcarrier.

STEPS Lever Switch:

Up position applies staircase to test signal. Down position removes the staircase.

90° SUBCARRIER Lever Switch:

The 90° subcarrier may be applied to 4 out of 5 lines when the APL IRE LEVEL rotary switch is in the 0 to 100 positions or to every line when the 0° SUBCARRIER and STEPS switches are down.

The OFF position provides no subcarrier. The UNMOD position provides a 30 mV, 90° subcarrier with no amplitude or phase modulation. The MOD position provides a 30 mV, 90° subcarrier for the first and last 13.2 μ s of each active line, a 305 mV, 90° subcarrier for the second 13.2 μ s, and a 610 mV, 90° subcarrier for the third 13.2 μ s.

APL/IRE LEVEL Rotary Switch:

The 50% position provides a staircase signal on each active video line. The 0 to 100 positions provide a staircase signal to one out of every five active video lines and a selectable luminance level on the remaining four. The 90° subcarrier can be applied to four of five lines (with the 0° SUBCARRIER and STEPS switches down, the APL is applied to every line including VITS STAIRCASE).

VITS

Consists of 2 three-position lever switches and a seven-position rotary switch to provide selection of the line and the field to which the vertical interval test signal is applied. Either color bar, APL, or staircase signal is available.

LINE Rotary Switch:

Provides selection of any line from line 15 through line 21 to which VITS is applied.

FIELD Lever Switch:

Provides selection of field one, field two, or both fields to which the VITS is applied.

SIGNAL Lever Switch:

MOD STAIRCASE position provides a VITS consisting of a five step (six level) modulated staircase which can be modified by the 0° SUBCARRIER and STEPS lever switches. When the 0° SUBCARRIER and the STEPS switches are down, and APL signal is applied to the VITS which can be modified with the 90° SUBCARRIER switch and APL IRE LEVEL rotary switch.

The OFF position removes the VITS. The COLOR BAR position provides a VITS consisting of a standard NTSC color bar signal which can be modified by the color bar lever switches (except the BARS switch).

CONVERGENCE

Consists of two lever switches and two potentiometers to control and position the display. The convergence signal is available to the CONVERGENCE PATTERN connector.

CROSSHATCH Lever Switch:

ON position provides a crosshatch display. (DISPLAY switch must be in CROSSHATCH or BOTH positions). VERT position provides vertical white bars only. HORIZ position provides horizontal white bars only.

DISPLAY Lever Switch:

The CROSSHATCH position pro-

vides a crosshatch display which can be modified by the CROSSHATCH switch. The BOTH position provides white dots centered in the rectangles formed by crosshatch. The DOT position provides white dots only.

VERT POSITION Control:

Potentiometer control moves display vertically for convenient alignment with screen of display device.

HORIZ POSITION Control:

Potentiometer control moves display horizontally for convenient alignment with screen of display device.

SYNCHRONIZATION Consists of four lever switches and a goniometer to control synchronization of signals.

R-Y PHASE Lever Switch:

90° position, R-Y axis is locked to 90°. (Normal NTSC operation). 270° position, R-Y axis is locked to 270°. (For tests only). ALT position, R-Y axis alternates between 90° and 270° at H rate. (For testing quadrature phasing only).

BURST Lever Switch:

Up position applies burst to COMP VIDEO output. Down position removes burst.

SYNC Lever Switch:

Up position applies horizontal and vertical sync pulses to composite video output. Down position removes sync pulses.

REF Lever Switch:

INT position provides internal sync generator and color standard. The EXT position provides externally

Operating Instructions—Type 140/R140

applied composite sync and color subcarrier inputs to synchronize all signals.

SUBCARRIER PHASE Control:

Goniometer control varies subcarrier phase of composite video output 360° in relationship to subcarrier reference (internal or external).

POWER

Toggle switch turns main power ON and OFF. Light: Indicates that the POWER switch is on and the instrument is connected to a line voltage source.

OVEN TEMP NORMAL LIGHT

When lighted, indicates that the Master Oscillator crystal oven is at normal operating temperature.

Output Connectors

All output signals are via BNC type connectors, and have a 75 ohm source impedance. For proper operation each output, when in use must drive a 75 ohm load.

CONVERGENCE PATTERN (Front and rear panel)

Provides a 1 V P-P composite video signal, consisting of composite sync and convergence pattern signals as selected by front-panel controls.

SUBCARRIER (Front and rear panel)

Provides a 2 V P-P sine wave output at subcarrier frequency (3.579545 MHz).

COMP SYNC (Front and rear panel)

Provides a 4 V composite sync pulse per EIA specifications.

COMP BLANKING (Front and rear panel)

Provides a 4 V negative-going composite blanking pulse per EIA specifications.

COMP VIDEO (Front and rear panel)

Provides 1 V P-P composite video signal consisting of composite sync and video test signals as selected by front-panel controls (except CONVERGENCE controls).

BURST FLAG (Rear panel)

Provides 4 V negative-going pulses coincident with burst.

HORIZ DRIVE (Rear panel)

Provides a 4 V negative-going pulse. Its leading edge is coincident with the start of line blanking.

VERT DRIVE (Rear panel)

Provides a 4 V negative-going pulse. Its leading edge is coincident with the start of vertical blanking.

Input Connectors

All input signals are via BNC type connectors and are loop-thru. For proper operation each input, when in use, must be terminated into 75 ohms.

SUBCARRIER (Rear panel)

Accepts a 3.579545 MHz signal 1 to 4 volts in amplitude.

COMP SYNC (Rear panel)

Accepts properly timed composite sync 2 volts to 4 volts in amplitude.

Test Setup Chart

Fig. 2-6 shows a drawing of the front- and rear-panel controls and connectors. This chart can be reproduced and used as a test setup record for special measurements and applications, or it may be used as a training aid for operation of the Type R140.

FIRST-TIME OPERATION

The following procedure demonstrates the use of the controls and connectors of the Type R140. Use of the Type R140 with three different display instruments is outlined for the convenience of the user. It is assumed that a video waveform monitor is available. A Vectorscope is essential if phase characteristics of the composite video output are to be observed. An oscilloscope is useful for observing sync, drive and other pulse outputs. It may be used to display all outputs except for phase characteristics.

Procedure 1

A Type RM529 Waveform Monitor is used as a display device in the following steps.

1. Check that the line voltage selector plugs are in proper positions for the line voltage to be applied. (See Installation). Connect the Type R140 to the power source and turn on the POWER switch.

2. Connect the COMP VIDEO output on the Type R140 to the A Video Input connector on the Type RM529 through a 75-ohm coaxial cable. If the other A Video Input connector is not used, connect a 75-ohm terminating resistor to the unused connector.



Operating Instructions—Type 140/R140

3. While the instrument is warming up (at least 5 minutes), set the instrument front-panel controls to these positions:

Type R140

COLOR BAR switches	All up
VIDEO	Up
MOD STAIRCASE switches	All up
APL/IRE LEVEL	50%
VITS switches	All up
LINE	18
CONVERGENCE switches	All up
SYNCHRONIZATION switches	All up

Type RM529

Vertical:

Input	A
DC Restorer	On
Response	Flat
Volts Full Scale	1.0 (Calib)
Position	Centered
Calibrator	Full Scale
Focus	Sharp Trace
Intensity	As desired
Scale Illum	Fully CW

Horizontal:

Position	Centered
Display	2 line
Mag	X1
Line Selector	18
Field	One
Sync	Int

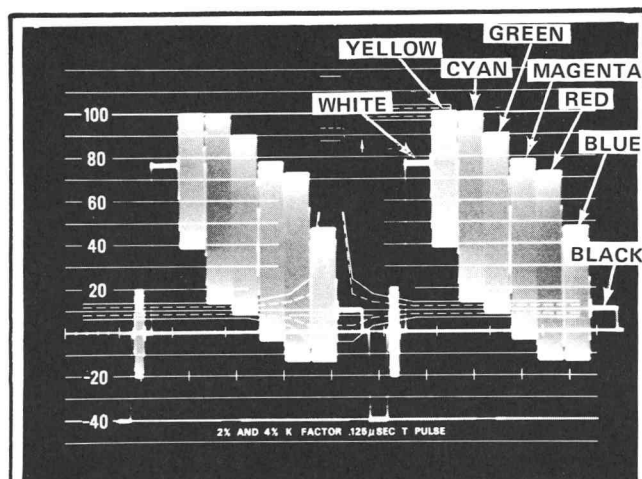
4. The display should consist of 2 lines of composite video, each containing a standard color bar test signal.

5. With the Type RM529 VERTICAL POSITION control, set the blanking level on the 0 graticule line (0 IRE). The sync tips should be at -40, the black level at 10, and the white level at 75 IRE units. Burst should be present between sync and the white luminance step. See Fig. 2-7 (A).

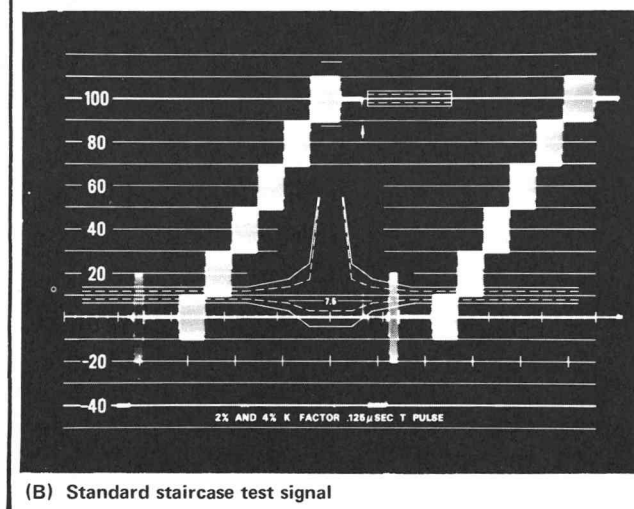
6. Change the COLOR BAR R-Y and B-Y switches to the down position. Note that the display is now showing the luminance (Y) component of the color bar test signal. Return the R-Y and B-Y switches to the up position.

7. Change the COLOR BAR Y switch to the down position. Note that the display is now showing only the chrominance components of the color bar test signal. Return the Y switch to the up position.

8. Change the COLOR BAR AMPL switch from the 75% amplitude position to the 100% amplitude position.



(A) Standard color bar test signal



(B) Standard staircase test signal

Fig. 2-7. Test signals available at COMP VIDEO output.

Note the change in amplitude of the color bars and white level. Return the AMPL switch to the up position.

9. Change the SETUP switch from the 10% position to the 7.5% position and note the change in black level. Now change the SETUP switch to the 0% position. In this position the black level is the same as the blanking level. Return the SETUP switch to the 10% position.

10. Change the WHITE REF switch to the 100 IRE position and note that the white reference bar moves to the 100% white position without changing the amplitude of the color bars. Return the WHITE REF switch to the up position.

11. Change the BARS switch from FULL FIELD to the -I, W, Q, B position. Note that the signal is a -I bar fol-

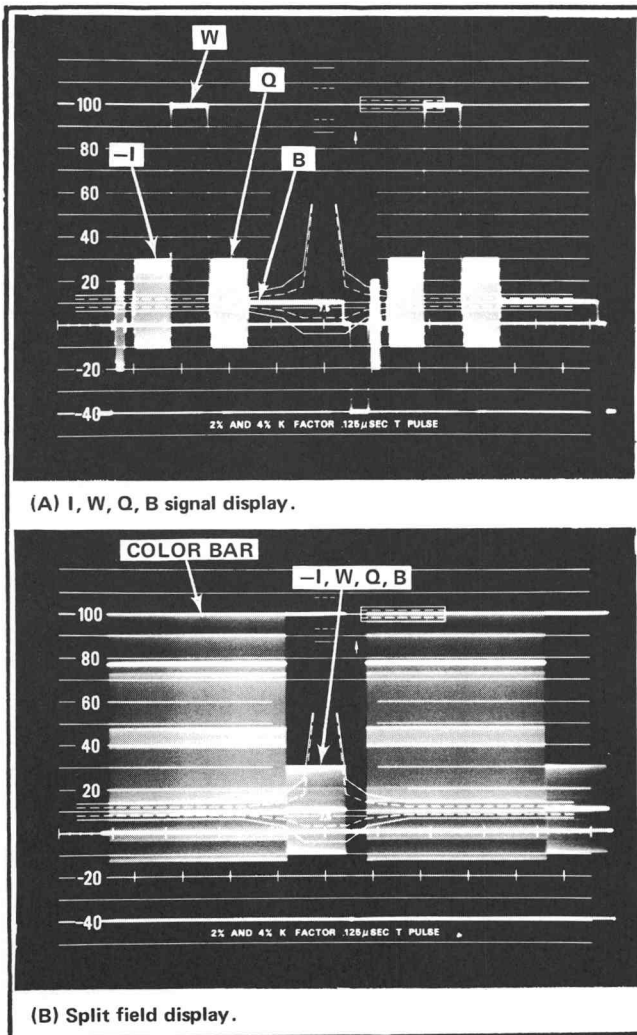


Fig. 2-8. Output waveforms controlled by the BARS lever switch.

lowed by a 100 IRE white bar, a Q bar, and then a black level for the remainder of the line. See Fig. 2-8(A).

12. Change the Type R140 BARS switch to the SPLIT FIELD position and the Type RM529 HORIZONTAL DISPLAY switch to the 2 FIELD position. Note that the field is split to include a color bar signal for the first 11.5 ms and a -I, W, Q, B signal for the next 3.8 ms. See Fig. 2-8(B). Return the BARS switch to the FULL FIELD position and the Type RM529 HORIZONTAL DISPLAY switch to the 2 LINE position.

13. Change the VIDEO switch to the OFF position. The display should consist of the sync pulses with the burst signal. Change the VIDEO switch to the down position. Now the signal can be altered with the controls in the MOD STAIRCASE section. The display should consist of a modulated staircase signal. See Fig. 2-7 (B).

14. Change the MOD STAIRCASE 0° SUBCARRIER switch to the down position. Notice that the modulation on each of the steps has been removed leaving only a luminance level for each step. Return the 0° SUBCARRIER switch to the up position.

15. Change the STEPS switch to the down position. This removes the steps leaving only the modulation. The modulation may also be removed with the 0° SUBCARRIER switch.

16. Change the Type R140 controls as follows:

0° SUBCARRIER	Down
STEPS	Down
90° SUBCARRIER	UNMOD
APL IRE LEVEL	0

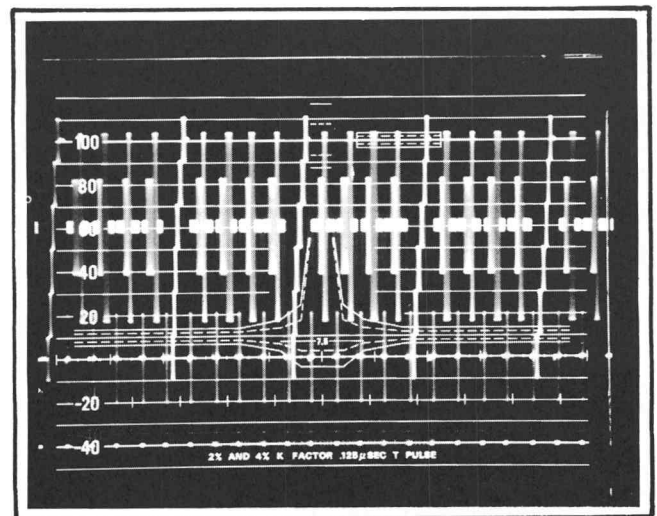


Fig. 2-9. Modulated 60 IRE level with modulated steps.

Note the APL offset chroma on each line including VITS.

17. Change the 90° SUBCARRIER switch to the MOD position. This applies modulation to the APL offset chroma. The APL level may be changed from 0 to 100 with the APL/IRE LEVEL rotary switch.

18. Change the Type RM529 Horizontal controls as follows:

Display	2 Field
Mag	X25

Change the Type R140 STEPS switch to the up position and note that a staircase signal now appears on one out of

every five lines in the active video region including VITS. Modulation can be applied to the steps with the 0° SUB-CARRIER switch. See Fig. 2-9. Return the MOD STAIRCASE switches to the standard signal position and the APL IRE LEVEL rotary switch to the 50% level.

19. Adjust the display with the Horizontal Position control on the Type RM529 so that the field blanking interval covers the screen. Change the Type R140 VIDEO switch to the up position and note the VITS staircase signal on line 18. See Fig. 2-10. The VITS signal may be put on different lines with the VITS LINE selector. The staircase may be changed to an APL signal by changing the 0° SUB-CARRIER and STEPS switches to the down position and rotating the APL IRE LEVEL switch (modulation can be applied with the 90° SUBCARRIER switch) or to a color bar signal with the VITS SIGNAL switch. The signal may be removed completely with the same switch by placing it in the center OFF position.

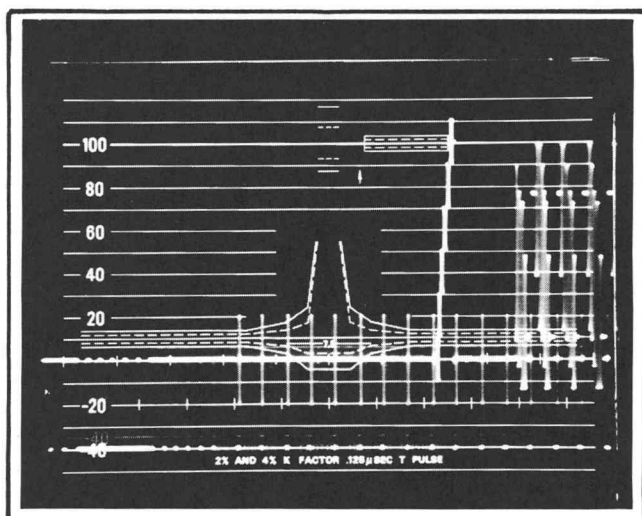


Fig. 2-10. Field blanking interval showing the VITS on line 18.

20. Change the Type RM529 MAG switch to the X1 position and center the display. Move the Type R140 VITS FIELD selector from 1 to BOTH and change the VITS SIGNAL selector to MOD STAIRCASE. Note that the VITS staircase appears on both fields. Now change the VITS FIELD switch from BOTH to 2 and note that the staircase appears on only field 2.

21. Change the Type RM529 Display selector to 2 Line and the DC Restorer to Off. Change the Type R140 SYNCHRONIZATION BURST switch to the down position and note that burst is removed from the composite video signal. Return the BURST switch to the up position.

22. Change the Type R140 SYNC switch to the down position and note that the sync pulses have been removed.

Procedure 2

A Type 545B Oscilloscope with a Type 1A1 Plug-In Unit is used as a display device in the following steps.

The oscilloscope used must have a bandwidth that is flat (uniform) in response from DC to approximately 5 MHz. An oscilloscope with a bandwidth of DC to 15 MHz (−3 dB frequency) or greater and a deflection factor of 0.1 V/cm or better is recommended. If the oscilloscope has insufficient bandwidth, the subcarrier and color bar chrominance signals will not be displayed with correct amplitude in relation to other signal components.

1. Connect the COMP VIDEO output connector on the Type R140 to one end of a 75-ohm coaxial cable. Connect a 75-ohm termination to the other end of the cable and then connect the termination to Input 1 connector on the Type 1A1 Plug-In Unit. Connect another 75-ohm cable from HORIZ DRIVE connector on the Type R140 to the Time Base A Trigger Input connector on the Type 545B. See Fig. 2-11.

2. Set the Type R140 front-panel controls as indicated in Step 3 of Procedure 1.

3. Set the Type 545B and Type 1A1 controls as follows:

Type 545B

NOTE

Since only Time Base A will be used in this procedure, settings of Time Base B, Delay-Time Multiplier and Amplitude Calibrator are not listed.

Time Base A:

Stability	Preset
Triggering Level	0 (centered)
Triggering Mode	AC
Trigger Slope	−Ext
Time/Cm	10 μSEC
Variable	Calibrated
Horizontal Display	A
5X Magnifier	Off
Horizontal Position	Centered Display
Intensity	As desired
Focus and Astigmatism	Sharp trace
Scale Illum	As desired.

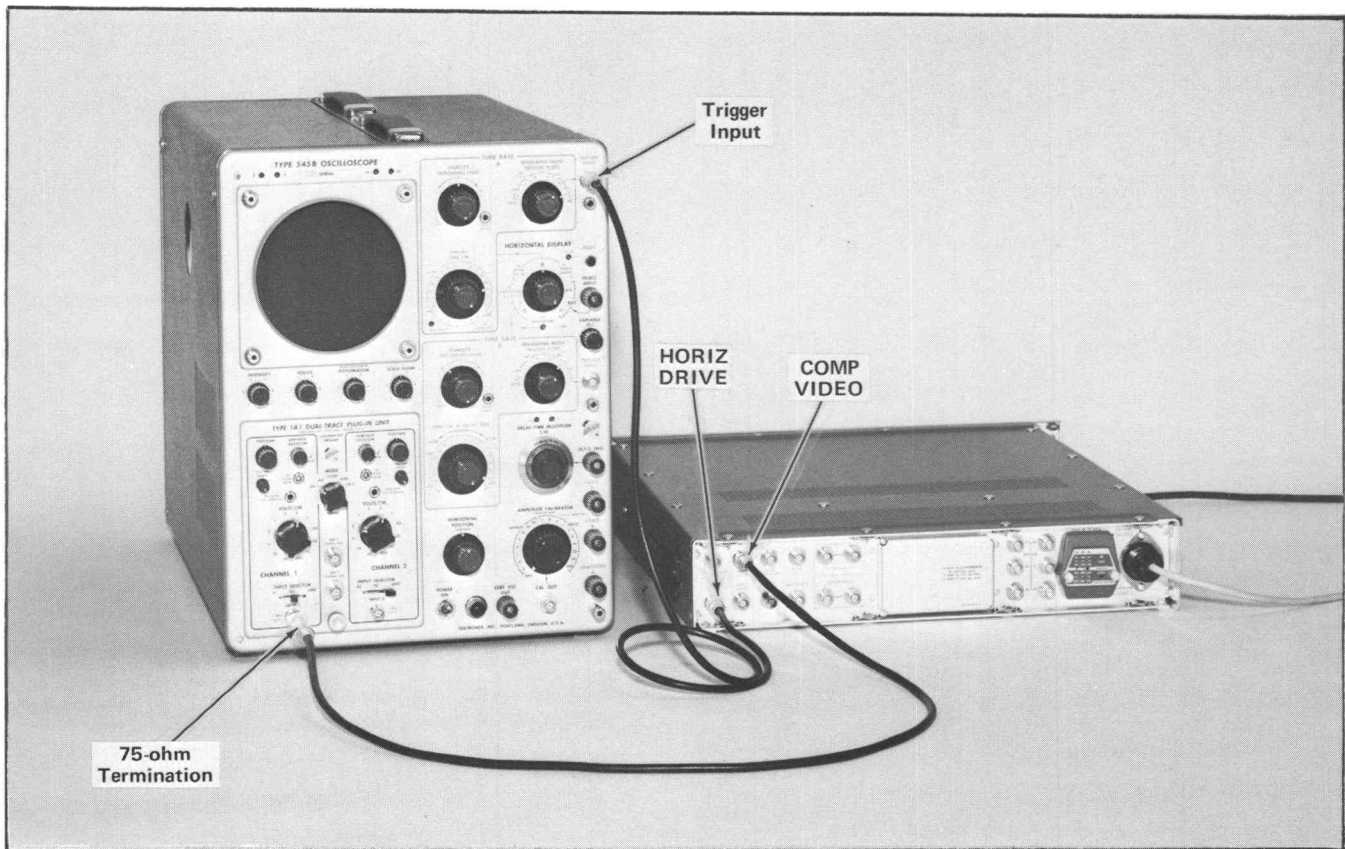


Fig. 2-11. Initial test equipment setup for First-Time Operation, Procedure 2.

Type 1A1**NOTE**

Since only Channel 1 will be used in this procedure, settings of Channel 2 controls are not listed.

Channel 1

Variable Volts/Cm	Calib
Pull For Invert	In
Mode	Ch 1
Volts/Cm	.2
Input Selector	DC
Position	Centered

4. Change the Type R140 controls as described in steps, 6 through 17 of procedure 1. (When performing Step 12 of Procedure 1, change the Type 545B Time/Cm switch to 5 ms and change the cable from HORIZ DRIVE connector to VERT DRIVE connector. When through with step 12, change the Type 545B Time/Cm Switch to 10 μ Sec and the cable from the VERT DRIVE connector to the HORIZ DRIVE connector). The displays will be the same as those obtained with the Type RM529, except there is no IRE scale on the graticule and the display will consist of approximately 1 1/2 TV lines.

5. Change the Type R140 STEPS and 0° SUB-CARRIER lever switches to the up positions. Change the Type 545B Trigger Slope control to -INT and the Time/Cm switch to .1 mSec. Adjust the Triggering Level control to obtain a stable display. The display should show that one line out of every five has a staircase signal and the other four should have a modulated 90° subcarrier on them.

6. Change the cable from the HORIZ DRIVE connector to the VERT DRIVE connector on the Type R140. Then change the Type 545B Triggering Slope selector to -Ext and the Time/Cm switch to .2 mSec. Adjust the Triggering Level control as necessary. The display should show the vertical blanking interval. Change the VIDEO switch on the Type R140 to the up position. Note the VITS staircase on one of the lines. Rotate the VITS LINE selector on the Type R140 and note that the VITS signal appears on different lines as the selector is turned.

7. Change the Type R140 MOD STAIRCASE STEPS and 0° SUBCARRIER switches to the down position. Rotate the APL IRE LEVEL switch. Note the change in IRE level of the VITS signal. Modulation can be added to the IRE level with the 90° SUBCARRIER switch. Change the VITS SIGNAL switch to the OFF position. Note that

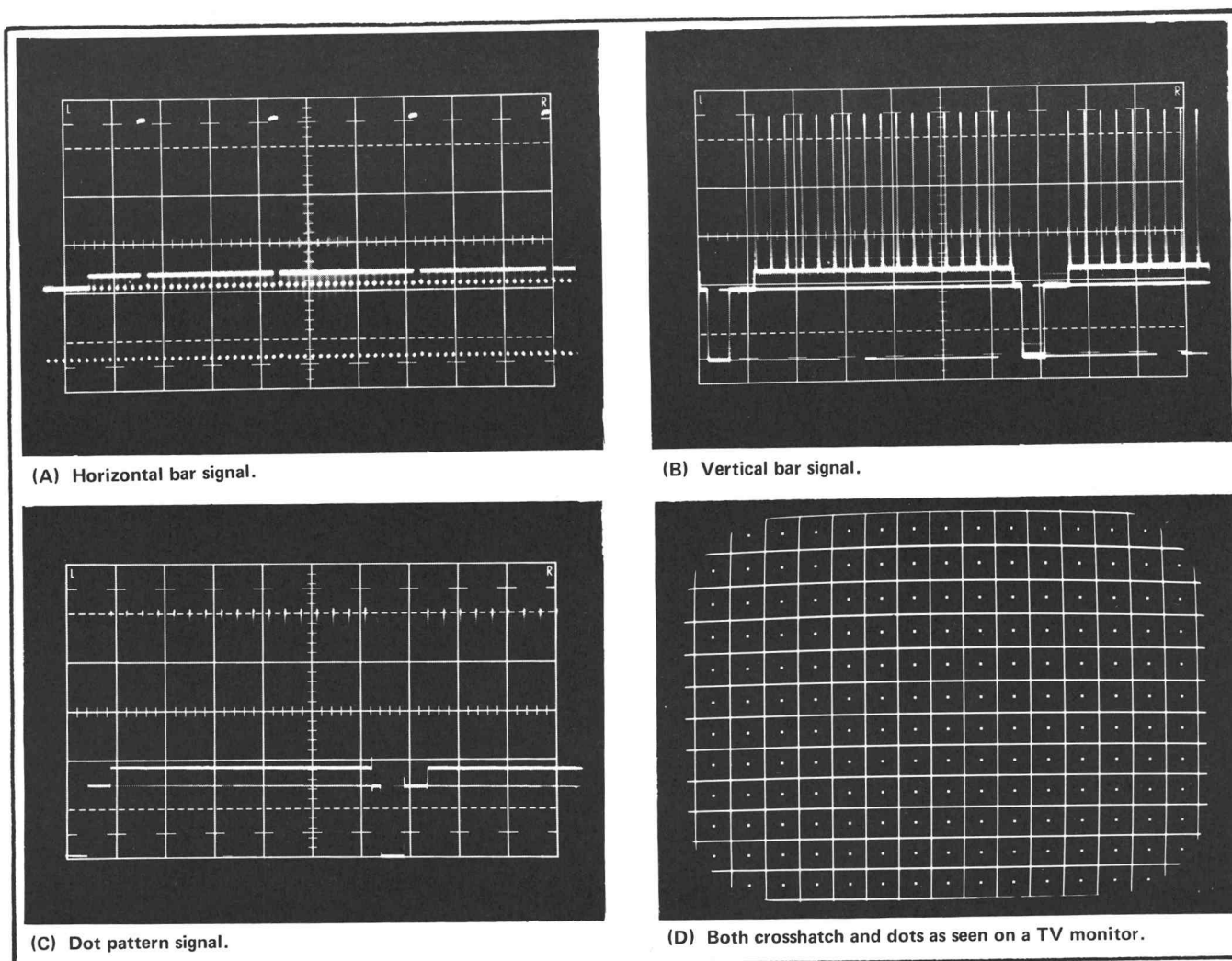


Fig. 2-12. Convergence pattern outputs.

the VITS staircase has been removed. Change the SIGNAL switch to the COLOR BAR position and note that the VITS now appears as a color bar.

8. Change the cable from the COMP VIDEO connector to the CONVERGENCE PATTERN connector on the Type R140. Change the Type R140 CONVERGENCE CROSSHATCH switch to HORIZ. Set the Type 545B Time/Cm switch to 2 mSec and the 5X Magnifier ON. Note the single line out of every 17 with a white luminance level. See Fig. 2-12(A). Its position can be changed with the VERT POSITION control on the Type R140. These pulses correspond to the horizontal bars as seen on the monitor. See Fig. 2-12(D).

9. Change the Type 545B Time/Cm switch to 10 μ Sec, the 5X Magnifier switch to Off, and the Trigger Slope switch to -Int. Change the Type R140 CONVERGENCE CROSSHATCH switch to VERT. Adjust the Type 545B Triggering Level control to obtain a clear display of 1 1/2

lines. The display should consist of a composite sync and blanking signal with 16 or 17 positive-going pulses along the line. See Fig. 2-12 (B). These pulses correspond to the vertical bars displayed on the monitor. See Fig. 2-12 (D).

10. Change the Type R140 CONVERGENCE DISPLAY selector from CROSSHATCH to DOT. The display should be similar to that seen in the previous step, but should have dim positive-going pulses. See Fig. 2-12 (C). These correspond to the dots as seen on a monitor. (Fig. 2-12 (D).)

11. Change the Type R140 CONVERGENCE DISPLAY selector from DOT to BOTH. The display should consist of both vertical bars and dots. The dot pulses should be between each of the vertical bar pulses.

12. Change the cable from the CONVERGENCE PATTERN connector to the COMP BLANKING connector.

Change the Type 1A1 Volts/Cm switch to 1 and the Type 545B Time/Cm switch to 50 μ Sec. Readjust the position control on the Type 1A1 to center the display. The display should be a series of negative-going pulses with an amplitude of 4 V. Pulse interval is 63.5 μ s and pulse duration is approximately 12 μ s.

13. Change the Trigger Slope Switch on the Type 545B to —Ext and the Time/Cm switch to 5 ms. The display should now be the composite blanking signal consisting of the horizontal and vertical pulses.

14. Change the cable from the COMP BLANKING connector to the COMP SYNC connector and the Time/Cm switch on the 545B to 50 μ Sec. The display should consist of the composite sync signals consisting of horizontal and vertical sync pulses.

15. Change the cable from the COMP SYNC connector to the SUBCARRIER connector. Change the Triggering Slope switch on the Type 545B to —Int and the Time/Cm switch to .2 μ Sec. Adjust the triggering Level control to obtain a stable display. The display should be a sine wave at the subcarrier frequency of 3.579545 MHz with an amplitude of 2 V P-P.

16. Change the cable from the SUBCARRIER connector to the BURST FLAG connector on rear panel of the Type R140. Change the Time/Cm switch on the Type 545B to 10 μ Sec. The display should consist of 4 V negative-going pulses coincident with burst.

17. Change the cable from the BURST FLAG connector to the HORIZ DRIVE connector. The display should consist of 4-V negative-going pulses coincident with the horizontal blanking interval.

18. Change the cable from the HORIZ DRIVE connector to the VERT DRIVE connector. Change the Time/Cm switch on the Type 545B to 10 mSec. The display should consist of negative-going pulses with an amplitude of 4 V. They are coincident with the vertical blanking interval.

Procedure 3

A Type R520 NTSC Vectorscope is used as a display device in the following steps. The Vectorscope provides a means of displaying phase characteristics as well as amplitude information, permitting graphic analysis of hue and saturation in the composite video signal.

R, G, B, Y, I, and Q components can also be conven-

iently displayed on the line sweep graticule of the Type R520 NTSC. See the Type R520 NTSC instruction manual operating instructions for measurement details.

Differential phase and differential gain measurements can be made using the Modulated Staircase test signal. The procedure for making measurements is detailed in the Type R520 NTSC instruction manual.

1. Connect the COMP VIDEO output on the Type R140 to the Ch A input on the Type R520 NTSC through a 75 Ω coaxial cable. If the other Ch A input is not used, connect a 75 Ω terminating resistor to the unused connector.

2. Set the Type R140 controls as indicated in Step 3 of Procedure 1.

3. Set the Type R520 NTSC controls as follows:

TYPE R520 NTSC

Signal Selector	Full field, A Φ , Ch A
Ch A 100%-75% Max Gain	75%
Ch A Gain	Cal
A Phase	As is
Ch B 100%-75%-Max Gain	75%
Ch B Gain	Cal
B Phase	As is
Ref	Burst
Function Selector	Vector
Luminance Gain	Cal
Calibrated Phase	0°
Intensity	As desired
Focus	Well defined display
Scale Illum	As desired
Field	1
Sync	Int
Vert Position	Midrange
Horiz Position	Midrange

4. The display should be a vector presentation of the chrominance portion of the color bar test signal.

5. Adjust the A Phase control on the Type R520 NTSC to align the burst vector to the 180° position. See Fig. 2-13.

6. Change the COLOR BAR R-Y lever switch on the Type R140 to the down position. The display should consist of the burst vector and 6 dots on the B-Y (or 0°-180° axis). See Fig. 2-14A. This display contains only the B-Y component of the color bar.

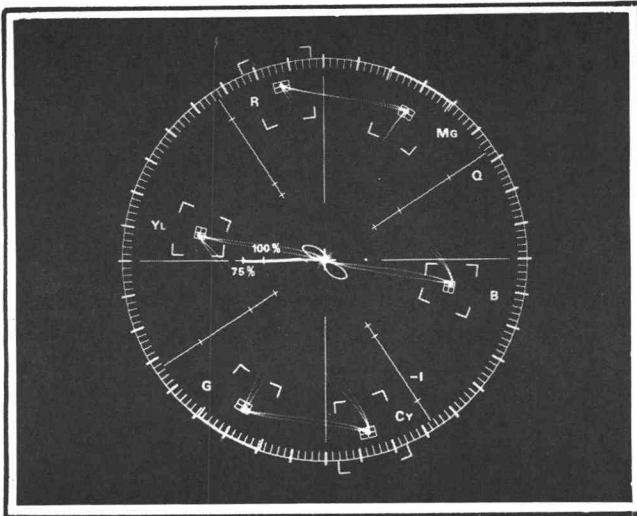


Fig. 2-13. Vector presentation of the color bar test signal. Position of the dots within the smaller boxes indicates that the displayed color vector are within $\pm 2.5^\circ$ phase and ± 2.5 IRE units amplitude limits.

Return the R-Y lever switch to the up position.

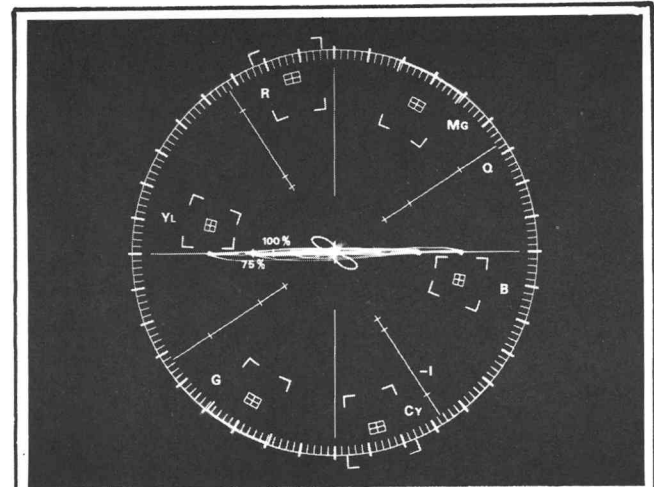
7. Change the COLOR BAR B-Y lever switch on the Type R140 to the down position.

The display should now be a vertical row of 6 dots on the R-Y (90° - 270°) axis plus the burst vector at 180° . See Fig. 2-14B. This display contains the R-Y component of the color bar.

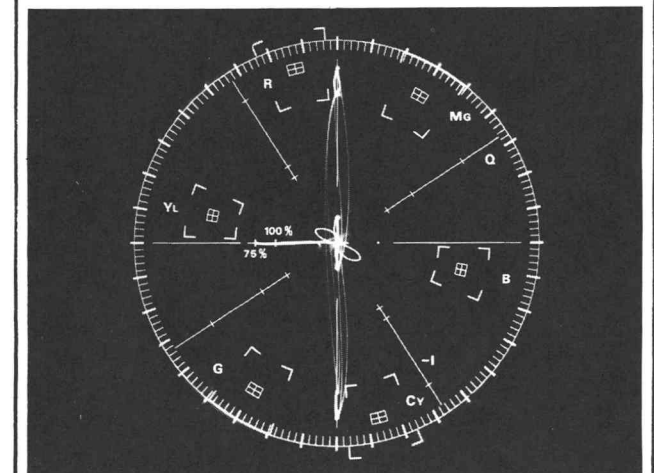
Return the B-Y lever switch to the up position.

8. All color vectors should fall within their respective inner boxes on the graticule (indicating that they are within $\pm 2.5^\circ$ phase and ± 2.5 IRE units amplitude error limits) when both R-Y and B-Y components are present in the color bar signal. See Fig. 2-13.

9. Change the COLOR BAR BARS lever switch on the Type R140 to the SPLIT FIELD position. There should be two additional vectors on the display; one on the Q axis, and one on the $-I$ axis.



(A) B-Y component of color bar test signal.



(B) R-Y component of color bar test signal.

Fig. 2-14. Vector display of color bar test signal containing only B-Y or R-Y components.

10. Change the BARS lever switch on the Type R140 to the $-I$, W, Q, B position. The display should now consist of three vectors, burst at 180° , $-I$ at 303° , and Q at 33° . Return the BARS switch to the FULL FIELD position.

11. Change the Type R140 SYNCHRONIZATION R-Y PHASE lever switch to the 270° position. The vectors should now be inverted. See Fig. 2-13.

12. Change the Type R140 SYNCHRONIZATION R-Y PHASE lever switch to the ALT position. This alternates the phase of the R-Y subcarrier between 90° and 270° at the H-rate. See Fig. 2-15. Return the R-Y PHASE lever switch to the 90° position.

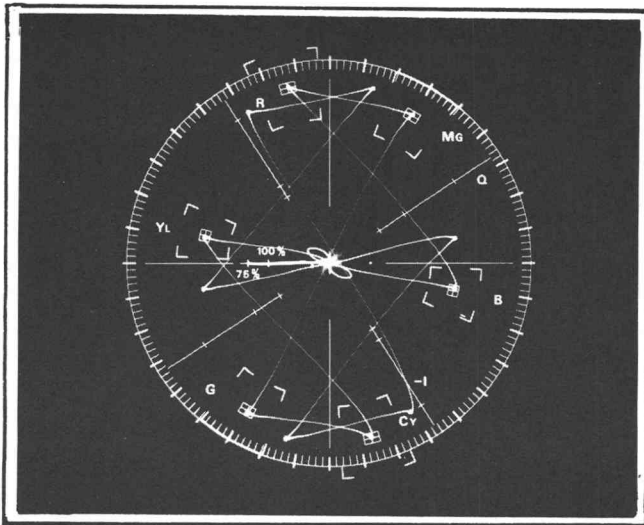


Fig. 2-15. Vector presentation of color bar test signal showing ALT R-Y PHASE.

13. Change the Type R140 VIDEO switch to the down position. There should be a vector at 0° as well as burst at 180° .

14. Change the Type R140 APL/IRE LEVEL rotary switch to the 0 position and the 90° SUBCARRIER switch to the MOD position. There should be a display consisting of burst at 180° , the 0° subcarrier at 0° , and 3 dots along the 90° axis corresponding to the modulated 90° subcarrier. See Fig. 2-16. Return the APL IRE LEVEL switch to the 50% position, the 90° SUBCARRIER lever switch to the OFF position and the VIDEO lever switch to the up position.

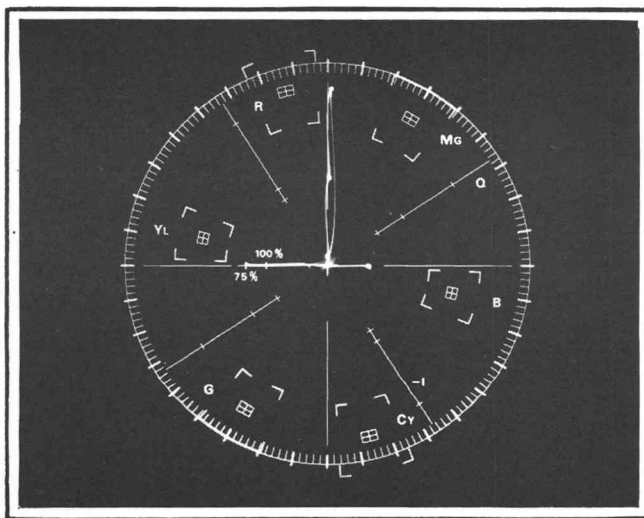
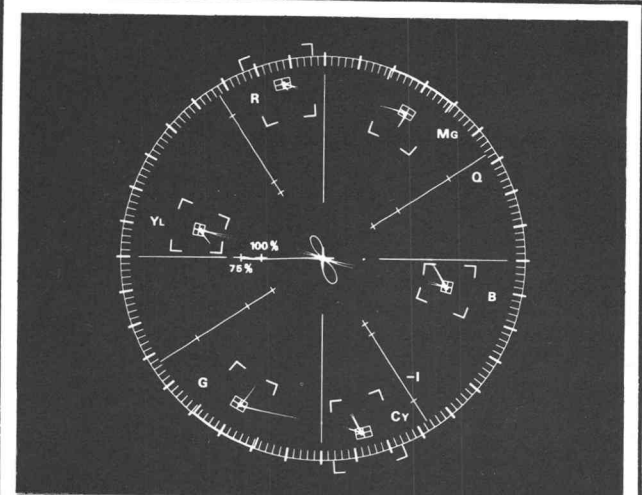
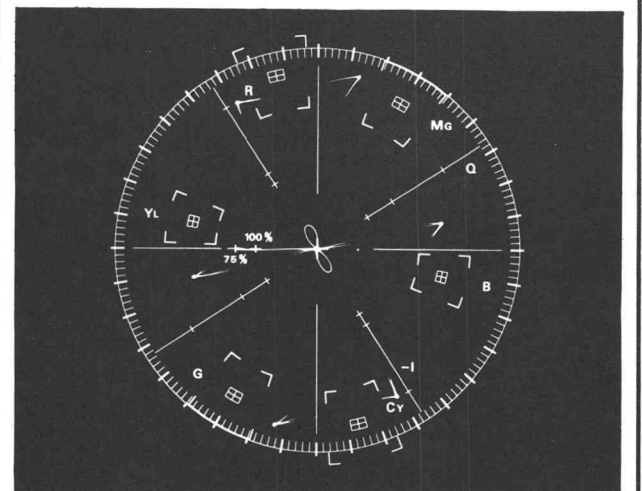


Fig. 2-16. Vector presentation of 0° and modulated 90° subcarriers.



(A) R-Y PHASE set to 90° .



(B) R-Y PHASE set to 270° .

Fig. 2-17. Vector display of color bar signal with R-Y PHASE set to 90° or 270° .

GLOSSARY OF TERMS

ACTIVE VIDEO LINES: All video lines not occurring in the vertical blanking interval.

APL: Average picture level. The average luminance level of the unblanked portion of a television line measured in IRE units.

BACK PORCH: That portion of the composite video signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLANKING LEVEL: The level of the front and back porches of the composite video signal.

BREEZEWAY: In NTSC color, the portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BURST FLAG: Pulses used to key out a portion of the 3.579545 MHz sine wave subcarrier for use as a reference for the color signal.

B-Y: A color signal corresponding to the 0° axis of a vector diagram. It is formed from a combination of red, green, and blue chrominance signals ($B-Y = -0.30R - 0.59G + 0.89B$).

CHROMINANCE: That property of light which produces a sensation of color in the human eye apart from any variation in luminance that may be present.

COLOR BAR: A test signal, typically containing six basic colors: yellow, cyan, green, magenta, red, and blue, which is used to check the chrominance functions of color TV systems.

COLOR BURST: In NTSC color systems, this normally refers to a burst of approximately 10 cycles of 3.579545 MHz subcarrier frequency of the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER: In color systems, this is the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information; in NTSC, it is a 3.579545 MHz sine wave.

COMPOSITE BLANKING: This signal is composed of pulses at line and field frequencies used to make the return traces of a picture tube invisible.

COMPOSITE SYNC: The line and field rate synchronizing pulses (including the field equalizing pulses) when combined together, from the composite sync signal.

COMPOSITE VIDEO: For color, this consists of blanking, field and line synchronizing signals, color synchronizing signals, chrominance and luminance picture information. These are all combined to form the complete color video signal.

CONVERGENCE: In color television, the meeting or crossing of the three electron beams at the shadow mask.

CROSSHATCH: A grid of vertical and horizontal white bars over a black background.

DIFFERENTIAL GAIN: The amplitude change, usually of the 3.579545 MHz color subcarrier, introduced by the overall circuit, measured in dB or per cent, as the picture signal on which it rides is varied from blanking to white level.

DIFFERENTIAL PHASE: The phase change of the 3.579545 MHz color subcarrier introduced by the overall circuit, measured in degrees, as the picture signal on which it rides is varied from blanking to white level.

EIA: An abbreviation for Electronic Industries Association.

EQUALIZING PULSES: Pulses of one half the width of the horizontal sync pulses which are transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulses. The purpose of these pulses is to cause the vertical deflection to start at the same time in each interval, and also serves to keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD: One half of a complete picture (or frame) interval, containing all of the odd, or all of the even, lines of the picture.

FIELD BLANKING: Refers to the blanking signals which occur at the end of each field. Also called vertical blanking.

FIELD FREQUENCY: The rate at which one complete field is scanned, normally 59.94 times a second.

FRAME: One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH: That portion of the composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding sync pulse.

H RATE: The time for scanning one complete line, including trace and retrace. NTSC equals $1/15734$ second (color) or 63.56 μ s.

HORIZONTAL DRIVE: A pulse at H-rate used in TV cameras. Its leading edge is coincident with the leading edge of the horizontal sync pulse and the trailing edge is coincident with the leading edge of the burst flag pulse.

HUE: The attribute of color perception that determines whether the color is red, yellow, green, blue, or the like. White, black, and gray are not considered hues.

IRE: An abbreviation for Institute of Radio Engineers.

IRE SCALE: An oscilloscope scale that applies to composite video levels. There are 140 IRE units in 1 volt.

—I, W, Q, B: An NTSC test signal used to check television broadcast equipment. It consists of a —I signal followed by a white bar then a Q signal and a black level on each line.

LINE BLANKING: The blanking signal at the end of each scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY: The number of horizontal scans per second, normally 15,734.26 times per second.

LUMINANCE: The amount of light intensity, which is perceived by the eye as brightness (referred to as "Y").

NTSC: National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

REFERENCE WHITE LEVEL: The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

R-Y: A color signal corresponding to the 90° position of a vector diagram. It is formed from a combination of red,

green, and blue chrominance signals ($R-Y = 0.70R - 0.59G - 0.11B$). Any color on the vector diagram can be made from a combination of R-Y and B-Y signals.

SATURATION: This indicates how little a color is diluted by white light, distinguishing between vivid and weak shades of the same hue. The more a color differs from white, the greater is its saturation. Saturation is also indicated by the terms purity and chroma. High purity and chroma correspond to high saturation and vivid color.

SETUP: The separation in level between blanking and reference black levels.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by the subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

SYNC: An abbreviation for the words "synchronization," "synchronizing," etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

VERTICAL BLANKING INTERVAL: The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulses, and VITS (if desired).

VERTICAL DRIVE: A pulse at field rate used in TV cameras. Its leading edge is coincident with the leading edge of the vertical blanking pulse and its duration is 10 1/2 lines.

VITS: Vertical interval test signal. A signal which may be included during the vertical blanking interval to permit on-the-air testing of video circuitry functions and adjustments.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

SECTION 3

CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section begins with a functional block diagram description. A complete block diagram (except for the Power Supply circuit) of the Type R140 is provided on a pullout page in Section 8.

Since this instrument uses numerous interconnections between stages to generate the composite video waveform, many of these interconnections must also be shown on the overall block diagram. To facilitate tracing the signal from one block to the next, the block diagram description that follows is keyed to the diagrams illustrated in Figs. 3-1 through 3-3. These illustrations divide the overall block diagram into 3 portions as follows:

1. Block diagram showing the stages required for generating the SUBCARRIER, VERT DRIVE, HORIZ DRIVE, COMP SYNC, CONVERGENCE PATTERN, BURST FLAG and COMP BLANKING output signals.

2. Block diagram showing the stages required for generating the MOD STAIRCASE composite video output signal.

3. Block diagram showing the stages required for generating the COLOR BAR or SPLIT FIELD composite video output signal.

Where possible, all interconnecting lines between stages show the number or type of signals on that line.

GENERATING THE SUBCARRIER, VERT DRIVE, HORIZ DRIVE, COMP SYNC, CONVERGENCE PATTERN, BURST FLAG AND COMP BLANKING SIGNALS (See Fig. 3-1)

To produce the above inputs, the block diagram description is broken into 2 portions (1) SUBCARRIER and (2) VERT DRIVE, COMP SYNC, CONVERGENCE PATTERN, BURST FLAG and COMP BLANKING.

The Master Oscillator generates the 3.579545 MHz subcarrier frequency. The 3.579545 MHz signal is then applied to the Oscillator Output stage. This output stage serves two main functions: (1) isolates the oscillator stage and (2)

maintains a constant output. From the Oscillator Output, the subcarrier is applied to the Subcarrier and Sync Source Switching circuitry. The switching stage is controlled by a front-panel switch (SYNCHRONIZATION REF) on the Type R140. With the switch in the INT position, the subcarrier generated in the master oscillator is used to drive the Subcarrier Limiter and Phase Lock Sampler. In the EXT position of the switch, the Oscillator Output circuit is disabled and an external 3.579545 MHz subcarrier may be applied to the Type R140 through the rear-panel SUBCARRIER INPUT connector. With external subcarrier applied to the Type R140, the Phase Lock Sampler circuitry is no longer referenced to the subcarrier and the subcarrier is applied only to the Subcarrier Limiter. Whenever an external subcarrier is used, an external composite sync may also be used. This signal is applied through the Type R140 rear-panel COMP SYNC INPUT connector. The external comp sync signal is integrated and peak detected to produce a field sync peak pulse to drive the Field Preset Gate.

The comp sync is also applied to a ramp generator which produces an H Sync Ramp Signal which drives the Phase Lock Sampler circuitry. External comp sync may also be used without subcarrier, but no chrominance information will be available at the outputs.

The Subcarrier Limiter stage accepts the subcarrier (internal or external) and insures a constant output amplitude of the signal to the Subcarrier Output stage. The Subcarrier Output stage is used as a distribution amplifier.

Other Output Signals

To produce the remaining output signals shown in Fig. 3-1, timing signals must be generated which are referenced to the subcarrier. The Line Frequency Control Oscillator, Line Counter, Line Detail Timing, Phase Lock Sampler, and the DC Control Loop Amplifier perform this function.

The Line Frequency Control Oscillator generates a 1.006993 MHz signal. This frequency is the 64th harmonic of the 15,734 Hz line rate, which is directly related to the subcarrier frequency. The 1.006993 MHz signal is applied to the Line Counter, which divides this frequency as needed by a 2, 4, 8, 16, 32, 64, and 128 sequence. After the 32nd

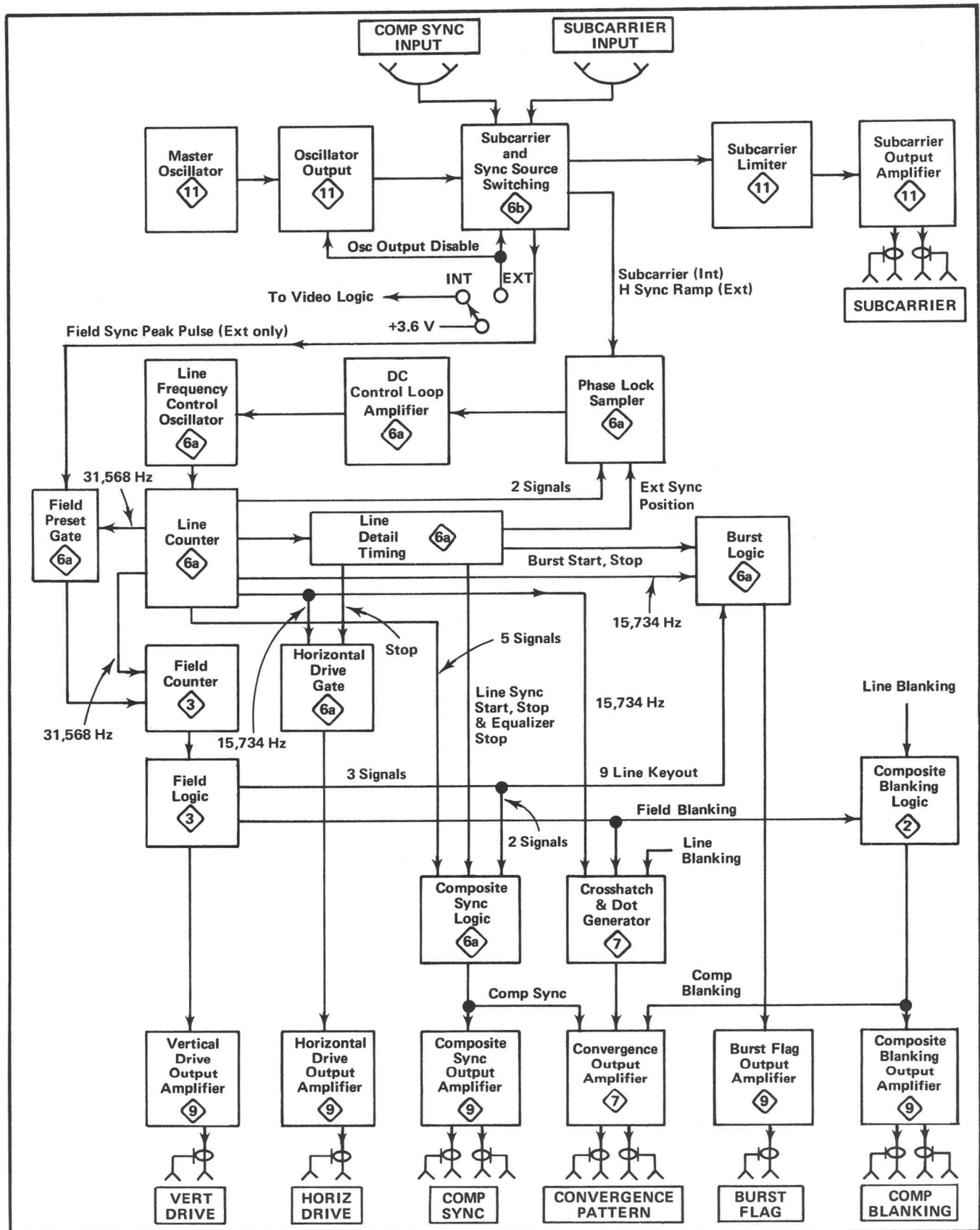


Fig. 3-1. Block diagram showing the stages required for generating the subcarrier, vert drive, horiz drive, comp sync, convergence pattern, burst flag and comp blanking output signals.

division of the 1.006993 MHz signal, a 31468 Hz signal is applied to the Line Detail Timing stage. This circuitry is used to determine the exact point at which the sampling takes place for generating other time-related signals. On the 64th and 128th divisions of the Line Counter, a signal is produced which is also applied to the Phase Lock Sampler. This occurs on every 455th cycle of the subcarrier, which is also applied to the Phase Lock Sampler (only if internal subcarrier is being used). Any time-shift of the Line Counter will be sampled against the subcarrier and a DC correction voltage will be applied to the DC Control Loop Amplifier. The loop amplifier amplifies the DC voltage obtained from the sampler and applies it to the Line Frequency Control Oscillator, which will change frequency and bring the Line Counter back into a lock with the subcarrier. With an external subcarrier applied to the Type R140, the Phase Lock Sampler will have no reference from which to operate and the oscillator will run at a predetermined frequency. With external subcarrier and comp sync applied to the Type R140, the circuits will operate as above (using the internal subcarrier) with the only exception being that an H sync ramp will be sampled in place of the subcarrier.

To provide a signal to the Horizontal Drive Output Amplifier, a pulse from the Line Counter sets the Horizontal Drive Gate flip-flop. A short time later another pulse from the Line Detail Timing stage resets the flip-flop and an output signal is obtained. This output is applied to the Horizontal Drive Output Amplifier.

Another stage driven by the Line Counter is the Field Counter. This circuitry is a 525 state Counter driven by the 31 kHz signal obtained from the Line Counter which provides the various outputs needed. When using external comp sync, the Field Preset Gate circuitry produces an output which presets the Field Counter. From the output of the Field Counter the signal is applied to the Field Logic circuitry. To obtain a signal to the Vertical Drive Output Amplifier, a pulse from the $\div 2$ field counter sets a vertical gate flip-flop. A short time later another pulse from the Field Counter resets the flip-flop and an output is obtained. This output is then applied to the Vertical Drive Output Amplifier.

To obtain drive signals to the Composite Sync Output, Composite Blanking Output and Burst Flag Output Amplifiers, signals from the Line Counter, Line Detail Timing, and Field Logic circuits are combined in the Composite Sync Logic and Burst Logic stages to produce the desired output signals to drive their respective output amplifiers. Line blanking is combined with Field Blanking in the Composite Blanking Logic stage to produce a drive signal to the Composite Blanking Output Amplifier.

The Vertical Drive, Horizontal Drive, Composite Sync, Burst Flag and Composite Blanking Output Amplifiers

amplify their respective input pulses which are then available at the front and rear panel VERT DRIVE, HORIZ DRIVE, COMP SYNC, BURST FLAG, and COMP BLANKING output connectors.

Line blanking, field blanking and a 15734 Hz signal from the Line Counter drive the Crosshatch and Dot Generator stage. This output is then applied to the Convergence Output Amplifier, where the composite sync and composite blanking signals are added to the signal. This signal is then amplified and available at the front and rear panel CONVERGENCE PATTERN output connectors.

GENERATING THE MODULATED STAIRCASE VIDEO OUTPUT SIGNAL (See Fig. 3-2)

Chrominance

To produce the chrominance portion of the modulated staircase, it is necessary that subcarrier be present to enable the Chrominance Output Amplifier. (See block diagram description for generating composite video, Fig. 3-3.)

Field and line timing signals are applied to the Video Logic stage which produces (1) staircase field drive and (2) APL field drive. The staircase field drive signal is applied via the 0° SUBCARRIER switch to the Staircase Chrominance Amplitude stage. Another gate from the Staircase Timing Logic stage is also applied to the Staircase Chrominance Amplitude stage. The combination of these 2 signals produces an output signal which is then applied to the +B-Y Filter. A burst signal from the Burst Amplitude stage is applied to the -B-Y Filter. The B-Y Filter limits the frequency response of each input signal to about 2 MHz so that the output drive signals to the B-Y Double Balanced Modulator have the same frequency response. Subcarrier is also driving the modulator, so a modulated output is obtained. This output is then applied to the Band Pass Filter. The filter has a center frequency response of 3.58 MHz to pass only the chrominance signal. This chrominance signal is then applied to the Chrominance Output Amplifier for amplification, and is available at the COMP VIDEO output connectors.

If the 0° SUBCARRIER and STEPS switches are set in the down (off) position and the 90° SUBCARRIER switch is set to UNMOD or MOD, the staircase field drive signal is disconnected from the Staircase Chrominance Amplitude stage (disabled by the 0° SUBCARRIER switch) and applied to the APL Chrominance stage via the above-mentioned switches. APL field drive from the Video Logic stage, 3 signals from the Staircase Timing Logic stage, and the line blanking are also applied to the APL Chrominance stage. These 6 signals are combined within the stage and an APL chrominance output signal is obtained. This chromin-

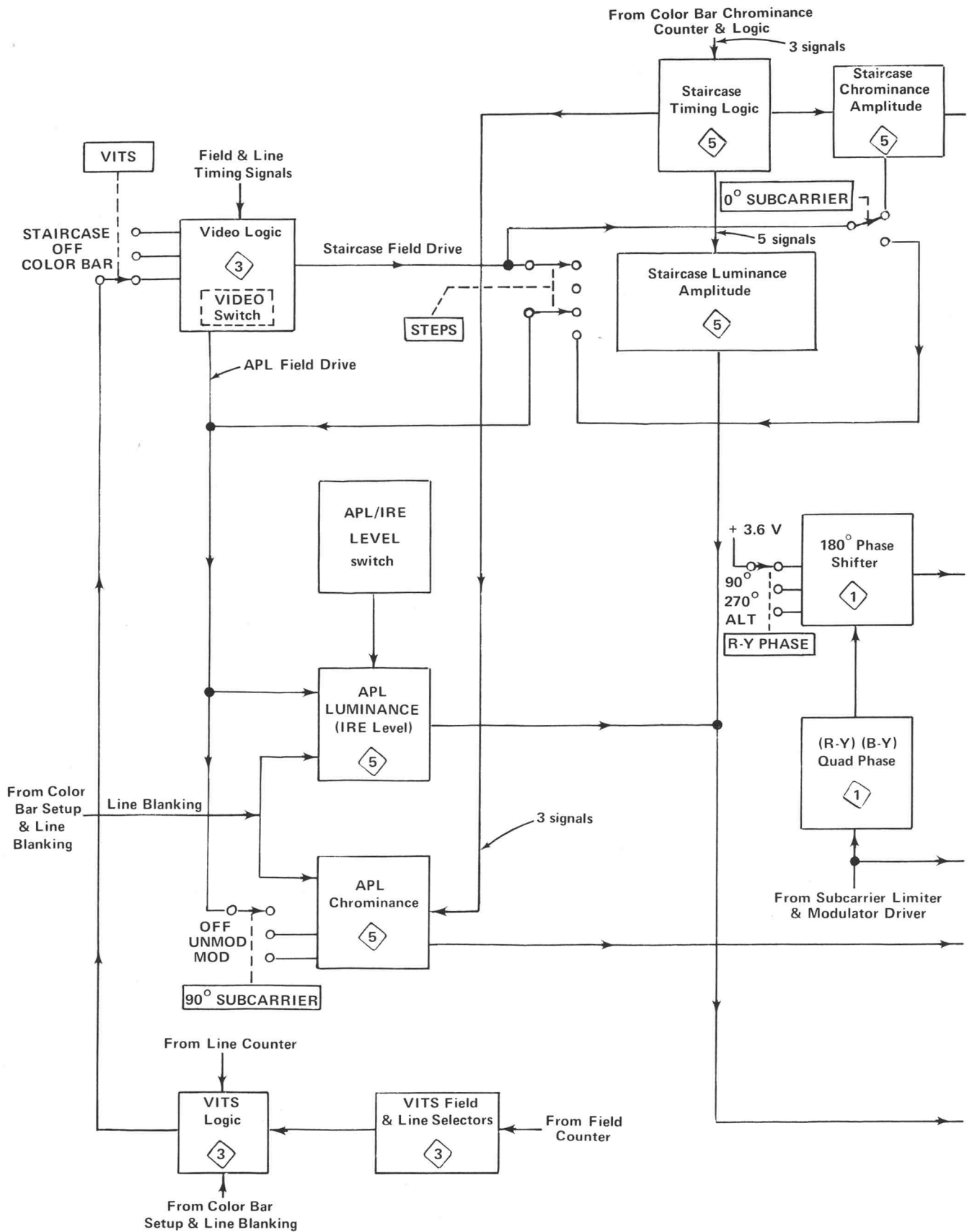


Fig. 3-2. Block diagram showing stages required for generating the modulated staircase composite video output signal.

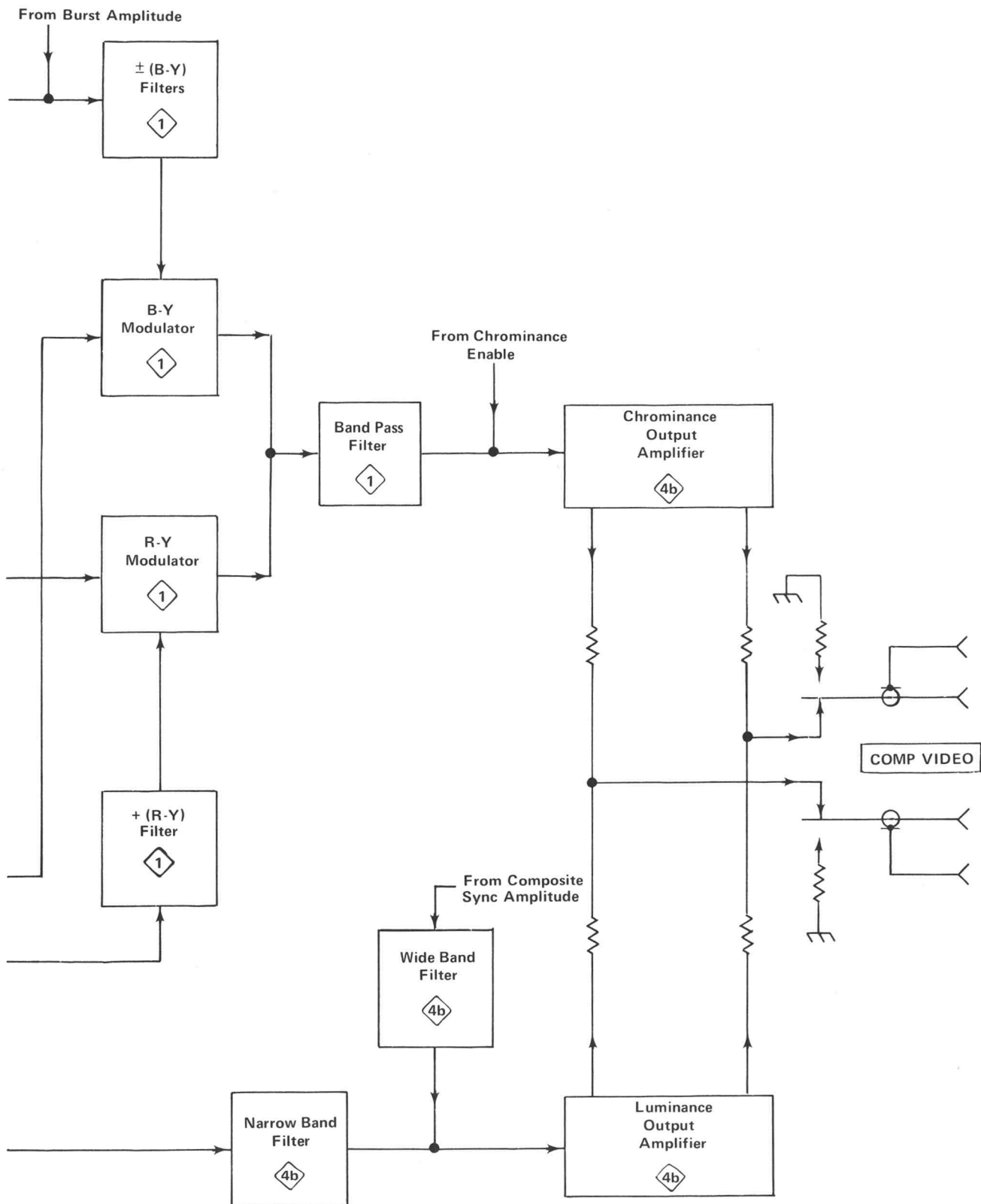


Fig. 3-2. Block diagram showing stages required for generating the modulated staircase composite video output signal.

ance signal is then applied to the + R-Y Filter. The output from the filter is applied to the + R-Y Modulator. Subcarrier also drives the R-Y Modulator via the 180° Phase Switcher and (B-Y) (R-Y) Quad Phase stages. Note that burst and subcarrier are also driving the B-Y modulator. The B-Y and R-Y Modulators are Double Balanced, and generate an output with burst displaced from the chrominance by 90°. This signal is then applied to the Band Pass Filter and Chrominance Output Amplifier as described earlier.

Luminance

To produce the luminance portion of the staircase signal (with switches set as shown in Fig. 3-2), 5 signals from the Staircase Timing Logic, Field Timing and from the Video Logic stage are combined in the Staircase Luminance Amplitude stage. The output is then applied to the Narrow Band Filter. Another drive to the Narrow Band Filter is the output from the APL Luminance stage. (This stage is controlled by the setting of the APL/IRE LEVEL switch and the APL field drive from the Video Logic stage.) The APL luminance and staircase luminance signals are then combined in the Narrow Band Filter. The filter also is used to minimize any harmonic frequencies that may adversely affect the chrominance in the output. The filter output is then applied to the Luminance Output Amplifier. Composite sync via the Wide Band Filter (see block diagram description for generating the composite video signal) is also applied to the output amplifier. These two signals are combined and amplified by the Luminance Output Amplifier. The output of the Luminance Output Amplifier is then available at the COMP VIDEO output connectors.

Note that separate output amplifiers are used: one for chrominance (Chrominance Output Amplifier) and one for luminance (Luminance Output Amplifier). Separate amplifiers minimize Differential Phase and Gain (see Glossary of Terms, Section 2).

GENERATING THE COLOR BAR OR SPLIT FIELD COMPOSITE VIDEO OUTPUT SIGNAL (See Fig. 3-3)

To produce the above outputs this block diagram description has been broken into two parts (1) Color Bar and (2) Split Field. Each of these parts are again separated into two parts (1) Chrominance and (2) Luminance.

Color Bar Chrominance

If any input signal to the Chrominance Output Amplifier is desired, subcarrier must be present. Without subcarrier, the Chrominance Enable circuit effectively shorts the input of the amplifier to ground.

Assume that the Bar Oscillator is on and the last color bar (blue) is being generated. At the end of blue, the output

drops to black or blanking. At this time, a stop signal is generated within the Color Bar Chrominance Counter & Logic stage. This output is applied to the Bar Oscillator Start & Stop Control stage, which disables the Bar Oscillator and color bars cease.

Seven signals are being applied to the Bar Oscillator Start & Bar Preset stage. At a predetermined time during the line blanking interval, a preset pulse is developed by the Bar Oscillator Start circuitry which presets the $\div 4$ Counter, Color Bar Chrominance Counter & Logic, and the Color Bar Luminance Counter & Logic stages. This is necessary to insure that the chrominance and luminance counters are synchronous. Just prior (one cycle of bar oscillator) to the position of the white bar, a second pulse is generated within the Bar Oscillator Start & Bar Preset circuitry which is applied to the Bar Oscillator Start-Stop Control stage, enabling the Bar Oscillator. The Bar Oscillator turns on. After one cycle of oscillation, the output triggers the $\div 4$ Counter, and color bars are again generated at the output.

The output of the Color Bar Chrominance Counter & Logic consists of three gate signals corresponding to the red, green and blue color signals. These signals are applied to the Color Bar Chrominance Amplitude stage. Also, applied to this stage via the R-Y and B-Y switches are the color bar field drive signals. Amplitude-setting voltages are also present from the Color Bar & Setup Voltage Supplies stage. The output of the stage is then applied to the B-Y and R-Y Filters. Note that burst is also applied to the B-Y Filter via the Burst Amplitude stage. The filters combine their respective inputs and limit the frequency response of these signals, which are then applied to the R-Y and B-Y Modulators.

Subcarrier is applied to the Subcarrier Phase (goniometer) stage which allows the operator to vary the phase of the subcarrier applied to the B-Y Modulator and (B-Y) (R-Y) Quad Phase stages. The quad phase circuitry shifts the phase of the subcarrier by 90° and applies it to the 180° Phase Switcher. The output of this stage is then used to drive the R-Y Modulator. The Modulators, being driven with the above mentioned signals, operate in a Double Balanced condition to produce an output which contains only the required sidebands of chrominance information. This chrominance information is applied to the Band Pass Filter and Chrominance Amplifier. (These circuits were discussed in the block diagram description for Fig. 3-2.)

Color Bar Luminance

Referring to Fig. 3-3, the output from the $\div 4$ Counter is applied to the Luminance Delay stage. This stage introduces a time delay for the luminance portion of the output signal so that both chrominance and luminance information is

combined properly at the COMP VIDEO output connectors.

The output of the Color Bar Luminance Counter & Logic stage consists of three gate signals corresponding to the luminance red, green, and blue. These signals are applied to the Color Bar Luminance Amplitude stage. Also driving this stage are the field and line drive signals. Amplitude-setting voltages are also present from the Color Bar & Setup Voltage Supplies stage. The output is then applied to the Wide Band Filter.

The Wide Band Filter is also driven by composite sync via the Composite Sync Amplitude Stage. The filter combines both signals and provides color bar luminance amplitude steps that are extended to the allowable bandwidth of the system. This signal is then applied to the Luminance Output Amplifier for amplification and use at the COMP VIDEO output connectors.

Split Field Chrominance

In the SPLIT FIELD mode of operation, the chrominance circuits operate in a manner similar to the COLOR BAR mode with the addition of the following stages: I, Q Chrominance Logic, I, Q Chrominance Amplitude, and the Bar Oscillator Frequency Control.

With SPLIT FIELD (or $-I, W, Q, B$) operation, a Bar Oscillator Frequency Control stage is used. This circuitry controls the frequency of the Bar Oscillator, which in turn controls the I, Q Timing.

The I, Q Chrominance Logic stage receives one gate from the Color Bar Luminance Counter & Logic stage and three gate signals from the Color Bar Chrominance & Logic circuitry. The output (I and Q drive signals) are applied to the I, Q Chrominance Amplitude stage. Also driving this stage are the I, Q drive gates from the Video Logic stage. The output signal is then applied to the $+B-Y$ and $\pm R-Y$ Filters. These filters and the remaining chrominance stages were discussed in the first part of this block diagram.

Split Field Luminance

In the SPLIT FIELD (or $-I, W, Q, B$) mode of operation, the luminance circuits operate as in the COLOR BAR mode with the addition of the following stages: I, Q White Drive and the I, Q White Amplitude.

To drive the I, Q White Drive stage, additional signals from the Color Bar Chrominance Counter & Logic and Luminance Counter & Logic stages are gated to produce a white drive gate. This gate is applied to the I, Q White

Amplitude stage. This output is then applied to the Narrow Band Filter. This filter and the remaining signal path for the luminance has previously been discussed in the block diagram description for Fig. 3-2.

INTEGRATED CIRCUITS

Many of the functions within the Type R140 are performed through the use of integrated circuits in the form of micrologic units. Complexities of the television composite sync waveform require numerous counting and logic functions for development of the signal. Gating of chrominance and luminance signals and generation of the staircase and color bar luminance signals are also accomplished by means of integrated circuitry.

Knowledge of the internal workings of the various micrologic units is not necessary for an understanding of circuitry in the Type R140, since the circuit description is concerned primarily with signal conditions at the input and output terminals of each unit.

Depending on external connections, several different functions may be performed by a single type of micrologic unit.

Rather than describe each unit's operation repeatedly throughout the circuit descriptions, each configuration will be explained here. The information in this portion can serve as reference material when studying the individual circuits.

Figs. 3-4 and 3-6 illustrate the various symbols which are used in this manual to designate micrologic units. A single unit may contain two or more sections which may be used separately. In these cases, one section will be labeled (A) and a second section will be labeled (B).

Micrologic Unit Configurations

Type F μ L 914 Dual Two-Input Gate.

Several different functional capabilities are indicated in the various connection arrangements for Type F μ L 914 in Fig. 3-4.

The basic symbol for this unit is illustrated in Fig. 3-4 (A). The F μ L 914 consists of two such units which may be used jointly or as completely separate circuit elements.

Fig. 3-4 (G) shows the symbol used in this manual to indicate that the desired input or output signals are "low".

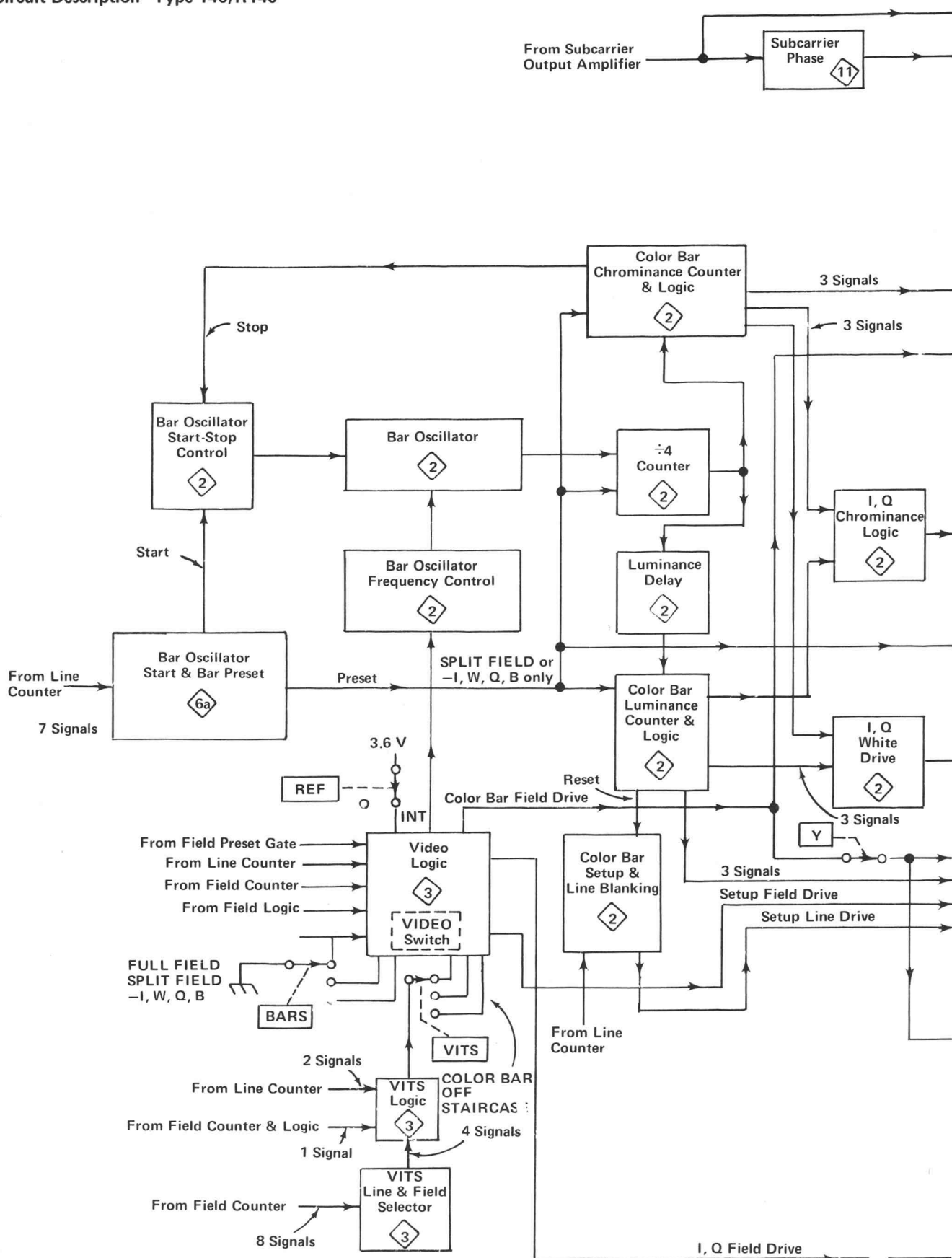


Fig. 3-3. BBlock diagram showing stages required for generating the color bar or split field composite video output signal.

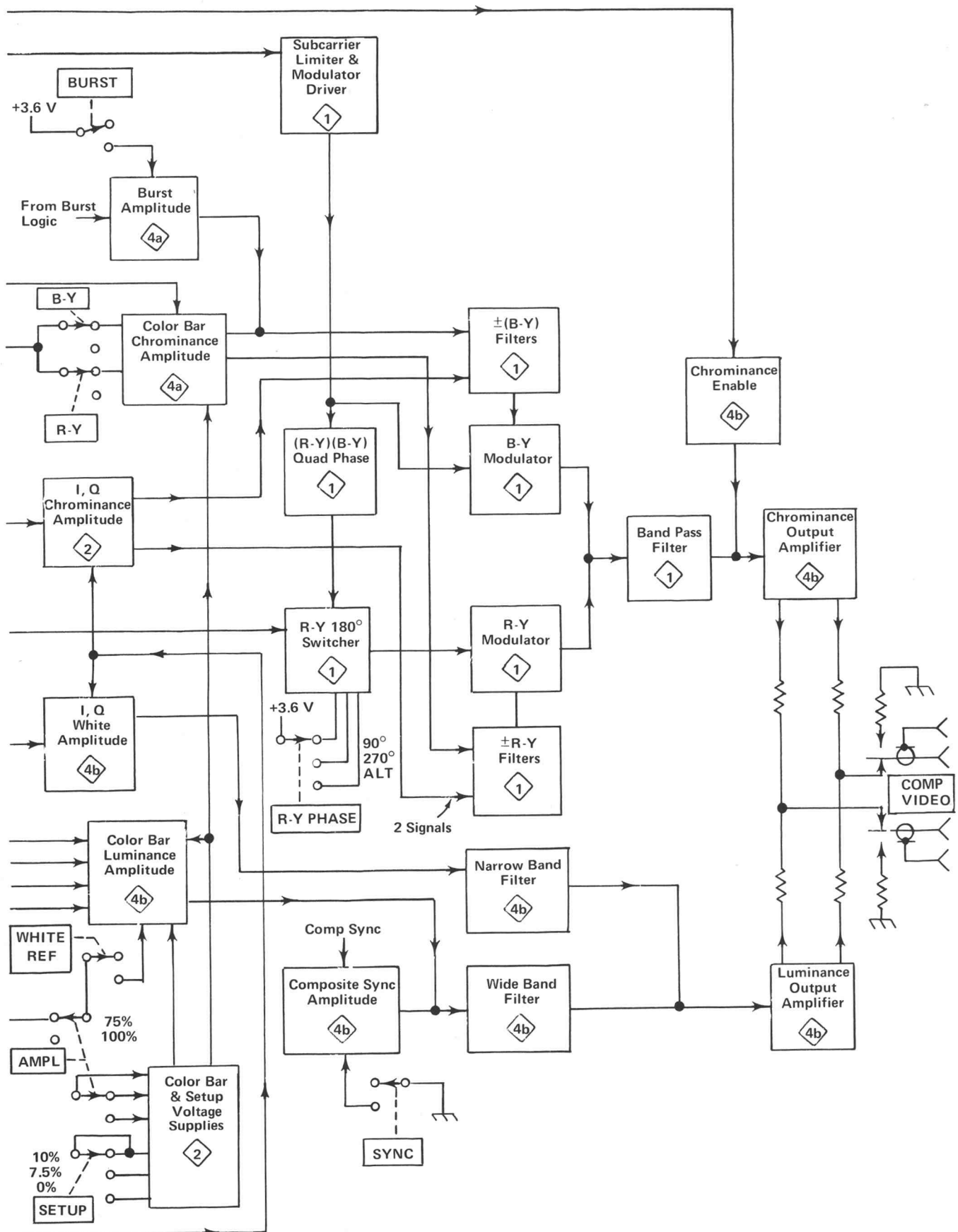
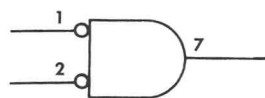


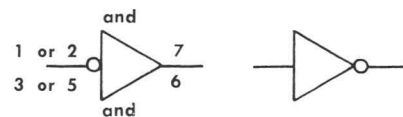
Fig. 3-3. Block diagram showing stages required for generating the color bar or split field composite video output signal.



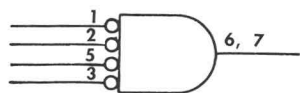
(A) AND GATE
($\frac{1}{2}$ F μ L 914)



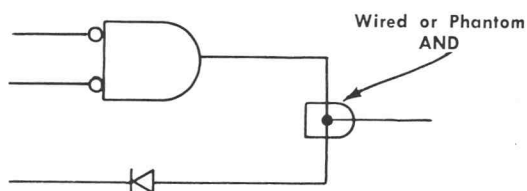
(B) OR GATE
($\frac{1}{2}$ F μ L 914)



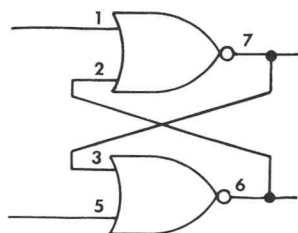
(C) Inverter or Buffer Stage
(F μ L 900 or $\frac{1}{2}$ F μ L 914)



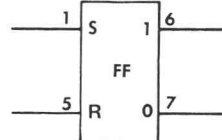
(D) 4-Input AND Gate



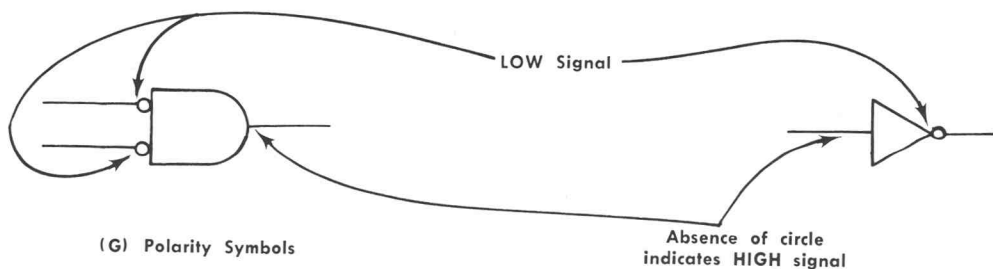
(E) Phantom AND Gate



(F1) 2-Input Set-Reset Flip-Flop
pin connections.



(F2) Schematic representation of
2-input set-reset flip-flop.



(G) Polarity Symbols

Fig. 3-4. Type F μ L 914 micrologic symbols and configurations as used in Type 140/R140.

A small circle between the input or output terminal and the connecting lead indicates that the signal causing the desired reaction at that point will be a "low". The absence of a small circle adjoining a connecting lead to a terminal indicates that the desired signal at that point will be a "high".

A "high" indicates a more positive voltage level, while a "low" represents a less positive (or ground) level signal.

In the Type R140 schematics and circuit description, the level-indicating symbols are used in a manner known as POSITIVE LOGIC.

Fig. 3-4(A) represents an AND gate, in which both inputs (pins 1 and 2) must be low to yield a high at the output (pin 7). Any other combination of inputs results in a low at the output. Table 3-1 is a truth table which shows the various combinations of signal levels for this two-input AND gate.

TABLE 3-1

Truth Table for 2-Input AND Gate

Input		Output
Pin 1	Pin 2	Pin 7
H	H	L
H	L	L
L	H	L
L	L	H

An OR gate is symbolized in Fig. 3-4 (B). The output of this OR gate will be low when pin 1, pin 2 or both pins 1 and 2 are high.

Fig. 3-4 (C) shows the symbols used for an inverter or buffer amplifier. The symbol with the circle at the input pin indicates that the input signal should be a low and the output will be high. The circle at the output terminal, of course, indicates the opposite. The inverter stages are actually one-half of one of the two-input AND gates in a Type F μ L 914. The input is the base of a transistor and the output is the collector. The emitter is grounded.

A four-input AND gate is shown in Fig. 3-4 (D). The output pins of the two AND gates are connected together. All four input pins must be low to achieve a high at the output terminal (pins 6 and 7).

When the output terminals of two or more separate devices or signal sources are connected together, the junc-

tion of their connection forms a "phantom" AND or OR gate. This is usually indicated by a small AND or OR symbol around the junction. Fig. 3-4 (E) illustrates a phantom AND symbol. This means that all signals must be present at the junction to develop the desired signal.

A two-input Set-Reset Flip-Flop is symbolized in Fig. 3-4 (F1 and F2). A description of a complete cycle of operation follows:

The Set-Reset Flip-Flop has two stable states. In one state, pin 7 will be high and pin 6 will be low. In the other state, the levels are interchanged. To begin the cycle, assume that at first pins 1 and 2 are low. Pin 7, and therefore pin 3, will be high. With either pin 3 or pin 5 high, pin 6 must be low. This is one stable state. To cause a change, a high is coupled to pin 1. Pin 7 must go low, setting pin 3 low. Assuming that pin 5 is also low, pin 6 (the output) will change to high. If pin 5 had been high due to a signal, the transition could not have occurred at that time.

Having changed to high on pin 6, the flip-flop will stay in this state until a high appears at pin 5. When this happens, pin 6 goes low, pin 7 goes high and the cycle is completed.

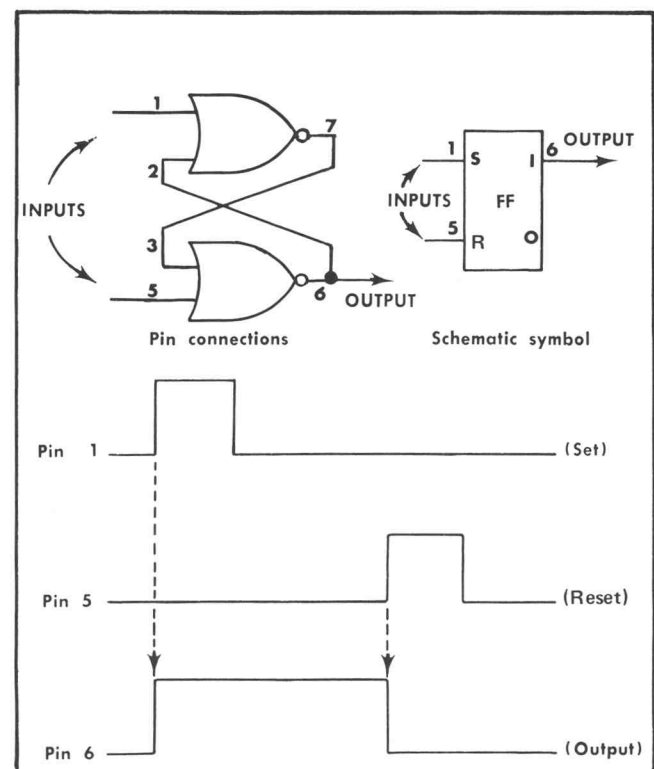


Fig. 3-5. Typical operation of 2-input Set-Reset Flip-Flop.

Circuit Description—Type 140/R140

In typical operation, the desired output is a positive pulse (high). A high or positive signal at pin 1 starts the positive pulse output at pin 6. Later, a high at pin 5 terminates the positive pulse out. Time between highs at pin 1 and pin 5 determines the pulse width. Fig. 3-5 illustrates normal operation for the Set-Reset Flip-Flop.

Type F μ L 923 JK Flip-Flop

Fig. 3-6 (A) shows the basic configuration when using the Type F μ L 923 as a triggered divide-by-two counter. To trigger, a negative-going transition is required at pin 2. The output pins (5 and 7) exchange polarity each time a negative-going transition arrives at pin 2. For example, the first trigger at pin 2 may cause pin 5 to go low. The next trigger sets pin 5 high. Pin 5 will go low every other trigger into pin 2, resulting in a divide-by-two countdown. When pin 5 is low, pin 7 is high and vice versa, similar to the two sides of a multivibrator.

In Fig. 3-6 (B), pin 6 is shown as an active element. This pin is typically used to preset the flip-flop so that the output pins start with the desired polarity at a certain time. When pin 6 is high, pin 5 will be high and pin 7 will be low. The high at pin 6 overrides any trigger input at pin 2 so that

the flip-flop can always be started with the desired polarity. When the high is no longer present at pin 6, the unit can resume triggered operation under control of pin 2.

A gated counter is illustrated in Fig. 3-6 (C). In this configuration, operation is similar to the triggered counter except that the flip-flop is inhibited from changing states during the time that pins 1 and 3 are high. When pins 1 and 3 are low, negative-going transitions at pin 2 will trigger the flip-flop in the normal manner.

In Fig. 3-6 (D), separate controlling signals are coupled into pins 1, 2 and 3. As in the gated counter, if pins 1 and 3 are both high, pin 2 cannot trigger the flip-flop. If pin 1 is high and pin 3 is low, the next negative-going transition at pin 2 will trigger the flip-flop so that pin 7 is high and pin 5 is low. If the flip-flop is already in that state when the trigger arrives at pin 2, no change will occur.

If pin 1 is low and pin 3 is high, the flip-flop will change states with a trigger at pin 2 as necessary to set pin 7 to low and pin 5 to high. Pin 7 output signal has the same polarity as pin 1 input signal and pin 5 output polarity will be the same as pin 3 input polarity.

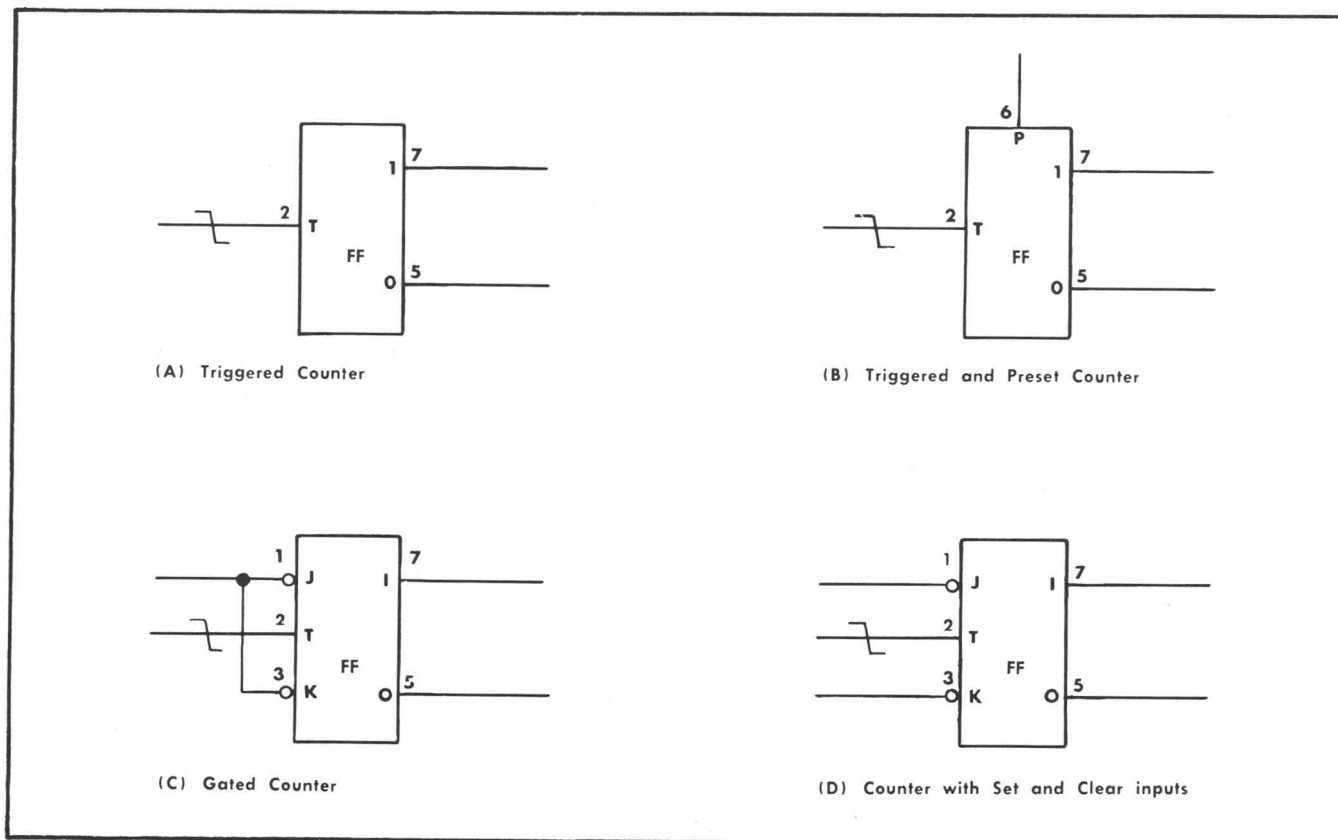


Fig. 3-6. Type F μ L 923 micrologic symbols and configurations.

When both pins 1 and 3 are low, the flip-flop will change states with each negative-going trigger at pin 2.

The preset input, pin 6, may be used in addition to the inputs at pins 1 and 3. A high coupled in to pin 6 will override any signals into pins 1, 2 and 3 and will preset pin 5 to high and pin 7 to low as previously described.

SUBCARRIER OSCILLATOR & OUTPUT



Subcarrier Oscillator

The Subcarrier Oscillator (Master Oscillator) is a crystal-controlled modified Colpitts oscillator with all critical components contained in a constant-temperature oven. Close control of oven temperature provides a frequency stability of better than ± 5 Hz over an ambient temperature range of 0° to $+50^{\circ}$ C.

The oscillator consists of Y1126, CR1122, Q1126 and Q1127. CR1122 is a voltage-variable capacitance which permits adjustment of the oscillator frequency. R1195 sets the operating bias on CR1122, thus setting the oscillator frequency. R1194 and R1196 are factory-selected to provide an adjustment range of ± 10 Hz about 3.579545 MHz. Q1127 supplies the sustaining feedback for the oscillator and serves as the output driving stage.

The use of two transistors (Q1126 and Q1127) in the oscillator allows the loop gain to be made non-critical with regard to transistor parameters and to be set so that the oscillator operates at approximately a 50% duty cycle.

Q1105 and Q1106 comprise the output stage of the oscillator. The oscillator signal is emitter-coupled from Q1105 to Q1106, which operates as a switching pair. A pulse current is determined by R1105 and drives the tank circuit, L1147, C1149 and C1152. The Q of the tank, and thus the subcarrier amplitude at the output, is determined by R6772 and R6782 on the Line Timing board. From the collector of Q1106, the subcarrier signal is coupled to the Subcarrier Source Switching circuitry.

When the front-panel REF switch is set to EXT, +3.6 V is applied to the anode of CR165 and thence to the emitters of Q1105 and Q1106. This reverse-biases both stages and thus eliminates the subcarrier signal in the collector circuit of Q1106.

Master Oscillator Oven

Oven temperature is sensed by a bridge network consisting of R1134, R1135, R1136 and R1137. R1134 and

R1137 are not sensitive to temperature, while R1135 and R1126 are nickel resistive elements with a temperature coefficient of $+0.55\%/^{\circ}\text{C}$.

When the oven is cold, R1136 is lower in resistance than R1134, making the base of Q1135B more negative than it is when the bridge is balanced. The collector of Q1135B is therefore more positive. This more positive level is coupled to the base of Q1133, which is an emitter-follower coupled to the base of Q1131, the driver for the heating element (R1131). The positive level on the base of Q1131 causes heavy conduction through the heating element and thus rapid heating of the oven chamber.

As the oven approaches normal temperature, R1136 increases in resistance, driving the base of Q1135B in a positive direction. This results in a less positive level at the base of Q1131, reducing the current through the heating element until a balance is achieved. At normal operating temperature, most of the heat is supplied by the power dissipation of Q1131. Normal temperature is about $+85^{\circ}$ C.

Oven Temperature Lamp

Normal operating temperature for the oven is indicated by a front-panel lamp which glows when the oven is at the proper temperature. The lamp is extinguished when the oven is either below or above normal temperature.

When the instrument is first turned on and the oven is cold, R1135 in the sensing bridge is lower in resistance than R1137, and the base of Q1135A is less negative than when the bridge is balanced. Q1135A collector current is greater, increasing the voltage drop across R1112. This sets the voltages in the divider consisting of R1112, R1114, CR1115 and R1116 so that Q1111 is cut off and CR1110 is in conduction through R1110. The resulting level at the base of Q1101, the lamp driver, holds Q1101 in cutoff. DS88, the indicator lamp in the collector circuit of Q1101 is off.

At normal temperature, R1135 and R1137 in the bridge are equal and the base of Q1135A is more negative than when the oven was cold. Collector current of Q1135A decreases, causing less voltage drop across R1112. This biases CR1110 cathode to a slightly positive voltage, thus allowing Q1101 to go into saturation, turning the indicator lamp on.

If the oven temperature should happen to rise above normal, R1135 will increase in resistance, making the base of Q1135A more negative than normal. This decreases collector current through R1112, causing the junction of R1112 and R1114 to become more positive. The base of Q1111 is now more positive, bringing Q1111 into con-

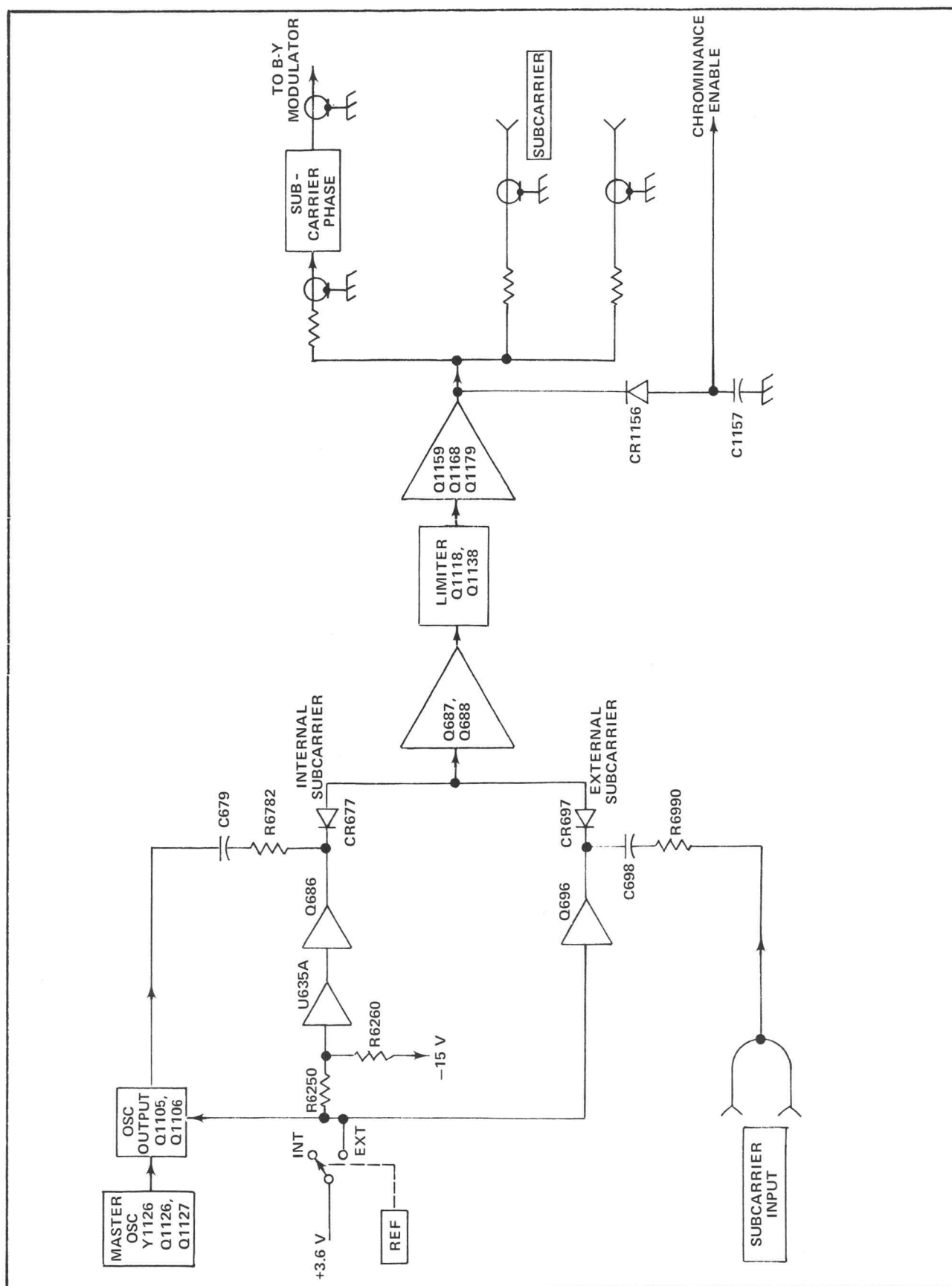


Fig. 3-7. Block diagram of Subcarrier Source Switching circuit.

duction. The drop across R1110 causes the base of Q1101 to drop, cutting off the collector current through the indicator lamp, which then goes off.

The oven is protected from overheating (due to a failure in the temperature control circuit) by the thermal cut-out switch S1131.

SUBCARRIER and SYNC SOURCE SWITCHING



Subcarrier Source Switching

The Subcarrier Source Switching circuit consists of S52 (REF), U635A, Q686, Q696, CR677, CR697, Q687 and Q688. (See Fig. 3-7.)

When the REF switch is set to INT, the base of Q696 is at approximately +2.9 V and Q696 is in saturation. The collector of Q696 is at approximately +3.5 V, biasing CR697 off. Inverter U635A sets the base of Q686 at approximately +3.5 V, causing Q686 to be near cutoff. The collector of Q686 is at approximately 0 V, permitting CR677 to be fully on.

The internal subcarrier is coupled through C679, R6782 and CR677 to Q687 and Q688, which are connected as an operational amplifier.

The base of Q677 is also set to approximately +3.5 V by U635A. Q677 is cutoff, thus allowing the current through R6781 to bias CR676 fully on. C678, R6772 and CR676 couple the internal subcarrier signal to the Phase Lock Reference Amplifier consisting of Q674, Q675, Q684 and Q694. From the Phase Lock Reference Amplifier, the signal is coupled to the Phase Lock Sampler to provide synchronization of the subcarrier and line sync signals.

When the REF switch is set to EXT, +3.6 V is applied to the top end of divider R6250-R6260. At the bases of Q677 and Q686, the voltage is now at approximately +2.9 V. Q677 and Q686 are in saturation with their collectors at approximately +3.5 V. CR676 and CR677 are biased off, so that any internal subcarrier signal present is diverted through Q677 and Q686. Also, with the REF switch set to EXT, +3.6 V is applied through CR1105 to the emitters of Q1105 and Q1106, the internal oscillator output stage (previously described). The bases of Q676 and Q696 are set to approximately +3.5 V, causing them to be cutoff. CR675 and CR697 are biased on via the current through R6780 and R6980 respectively.

The external subcarrier signal is coupled through R6990, C698 and CR697 to the Subcarrier Amplifier (Q687 and Q688).

Ext Sync Processing

If external composite sync is applied to the instrument, this signal is coupled through Q656, which serves as a termination for the input signal. Thence the signal is coupled through the Ext Horiz Sync ramp generator consisting of Q666, Q667, Q668 and Q669 via R6770 and CR675 to the Phase Lock Reference Amplifier. The signal is then coupled to the Phase Lock Sampler.

Q666 and Q667 are a switching pair which convert the sync pulses to constant current pulses from the collector of Q667. Q669 is normally saturated, but during a sync current pulse it generates a 2.5 V/ μ s ramp. The top of the ramp is limited at 5 V by Q668. After the sync pulse, R6770 becomes a current source of opposite polarity so the ramp goes in the opposite direction back down to approximately 0 V.

The purpose of integrating the external horizontal sync pulses is to eliminate most noise impulses from the output signal and provide a ramp to be sampled. (See Fig. 3-8.)

The external composite sync signal is also coupled to the Ext Vert Sync ramp generator and peak detector consisting of Q646, Q647, Q648, CR648 and Q649 and thence to U619 to initiate a field preset signal.

Q646, Q647 and Q648 form a vertical ramp generator similar to the Ext Horiz Sync ramp generator except the time constants are much longer. The entire field sync pulse duration (3 lines) is required for the ramp to reach 5 volts. Thus, line sync pulses, equalizing and serrated pulses have no appreciable effect.

At the exact peak of the ramp, the point is reached at which CR648 is forward biased. This occurs near the end of the last serrated pulse. (See Fig. 3-8.) The conduction of CR648 through C647 and R6480 briefly (approximately 10 μ s) turns on Q649, resulting in a negative-going impulse at the collector of Q649. R6490 and C649 provide positive feedback, making the peak-detection more definite.

Goniometer Drive and Subcarrier Output Amplifier



The subcarrier signal appearing at pin connector N is coupled through the Limiter (Q1118 and Q1138) to the

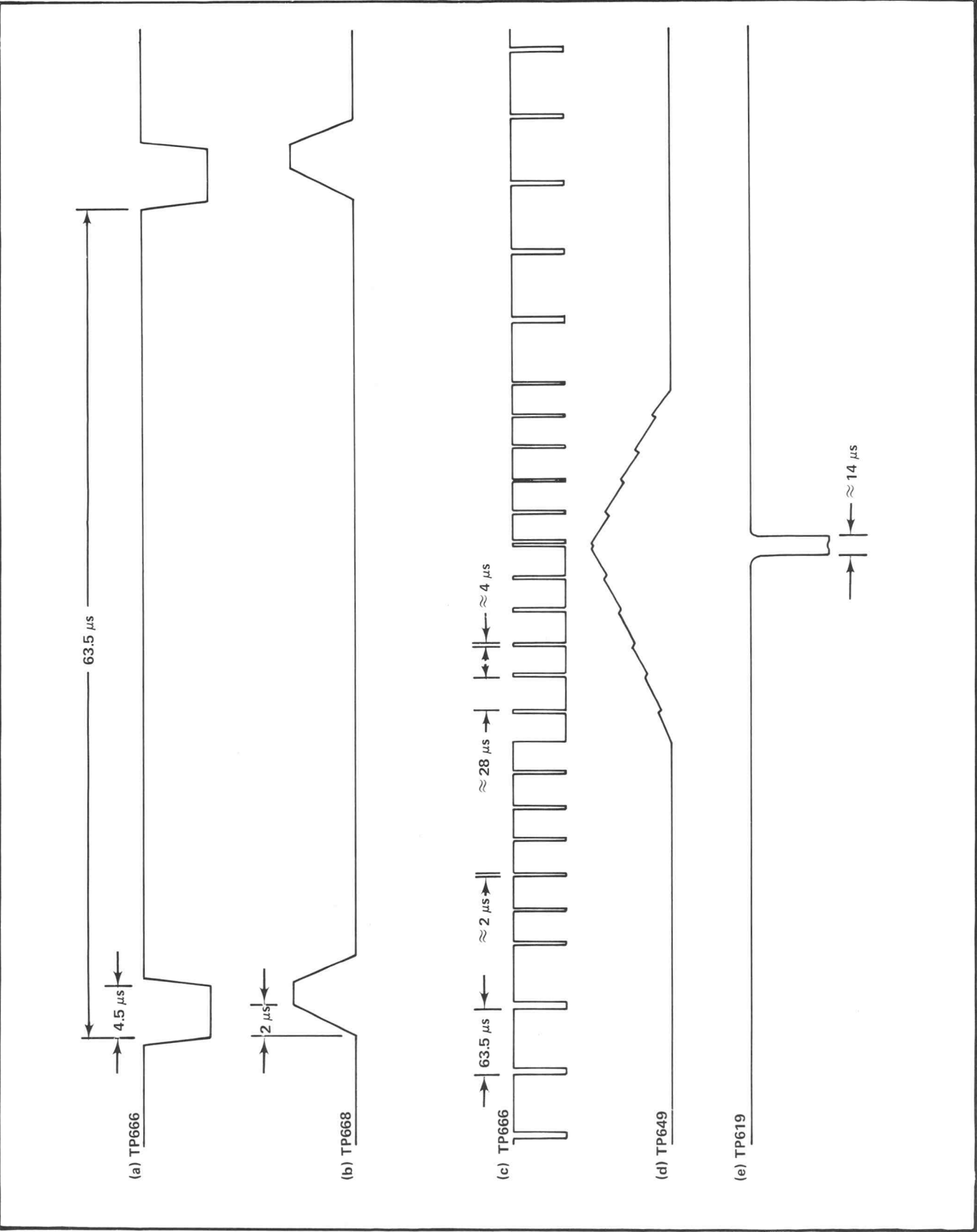


Fig. 3-8. Time related waveforms in the Ext Horiz Sync Amp (a and b) and the Ext Vert Sync Amp (c, d and e).

Goniometer Drive and Subcarrier Output Amplifier consisting of Q1159, Q1168 and Q1179.

L1197 is tuned to resonance at the subcarrier frequency. Q1168 and Q1179 act as a switching pair for the current from R1121.

Q1159 and Q1179 are connected as an operational amplifier. From the amplifier, the subcarrier signal is coupled to the front- and rear-panel SUBCARRIER output connectors and to the goniometer (SUBCARRIER PHASE).

Chrominance Enable and

The Chrominance Enable circuit consists of CR1156, C1157, Q471, Q481 and Q491. The purpose of this circuit is to eliminate extraneous noise which may appear at the Video Output Amplifier when no subcarrier signal is present.

When the subcarrier signal is present as an output from the emitter of Q1159, CR1156 is forward biased during the negative half-cycles, putting a negative-voltage charge across C1157 and at pin connector K.

This negative voltage at pin K is coupled to pin AW on the Bar Drive and Video Out board and thence to the base of Q471. Q471 is then forward biased, with its collector becoming less negative. The divider R461, R471 and R491 sets the base of Q481 to several volts positive, reverse-biasing the base-emitter junction of Q481. The base of Q491 becomes negative, cutting off current through Q491.

In the absence of a subcarrier signal at CR1156, Q471 is reverse-biased, Q481 is forward-biased and Q491 is in saturation. Noise signals at the junction of C491 and R481 are shunted to ground through C491 and Q491.

LINE TIMING

Phase Lock Sampler

The Phase Lock Sampler circuit consists of U633, Q645, T655, C655, C665, R6540, R6640, CR654 and CR664.

The circuit samples a signal from either the internal subcarrier oscillator or integrated external horizontal sync with the output from U6333, a three-input AND gate. Pin 1 of U633 is from the External Sync Position circuit (Line Detail Timing). Pins 3 and 5 are driven by 15,734 Hz and 7867 Hz signals from the Line Counter, causing the output

of U633 to be a sub-harmonic of the Line Frequency Control Oscillator as well as of the sub-carrier frequency. The sampling rate is increased to the line rate when sampling external horizontal sync.

The resulting output from the Phase Lock Sampler is a DC voltage which is used to phase lock the Line Frequency Control Oscillator frequency to an exact ratio (128:455) with respect to the subcarrier oscillator frequency or the external horizontal sync rate (64:1).

The signal at the junction of CR654 and CR664 is either sinewaves at the subcarrier frequency or integrated horizontal sync pulses from the Phase Lock Reference Amplifier. The sync pulses are limited, integrated and amplified in order to provide a positive-going ramp to be sampled. The waveforms are symmetrical from zero volts (equal positive and negative excursions).

The output from U633 is a positive pulse occurring at one-half the line rate (7867 Hz) when sampling the subcarrier and the line rate (15,734 Hz) when sampling external sync. This signal is applied to the base of Q645, driving Q645 into cutoff. (Q645 is normally in saturation.) The collapse of field in the primary of T655 causes a negative spike approximately 50 ns wide at the collector of Q645. This narrow spike appears across the secondary of T655, with about -5 V at the C665 end and $+5$ V at the C655 end. This forward biases CR654 and CR664, which couples the voltage at the diode junction (less the diode drops) to the diode ends of C655 and C665 respectively.

After the pulse, the transformer end of the capacitors returns to ground potential, causing the diode ends of C655 and C665 to be -5 V (plus diode drop plus sampled voltage) and $+5$ V (less diode drop plus sampled voltage) respectively. The voltage now appearing at TP663 is the average of these two voltages, or simply the sampled voltage.

If the spike occurs at the time that the waveform at the junction of CR654 and CR664 passes through zero volts, the result at the junction of R6540 and R6640 will be zero volts. When the spike occurs at a negative or positive voltage, the output will be either a negative or positive voltage. (See Fig. 3-9.)

DC Control Loop Amplifier

Q673A, Q673B, Q683 and Q693 comprise the DC Control Loop Amplifier circuit.

To provide minimum loading of the Phase Lock Sampler circuit, a FET (Q673A) is used as the input stage of the

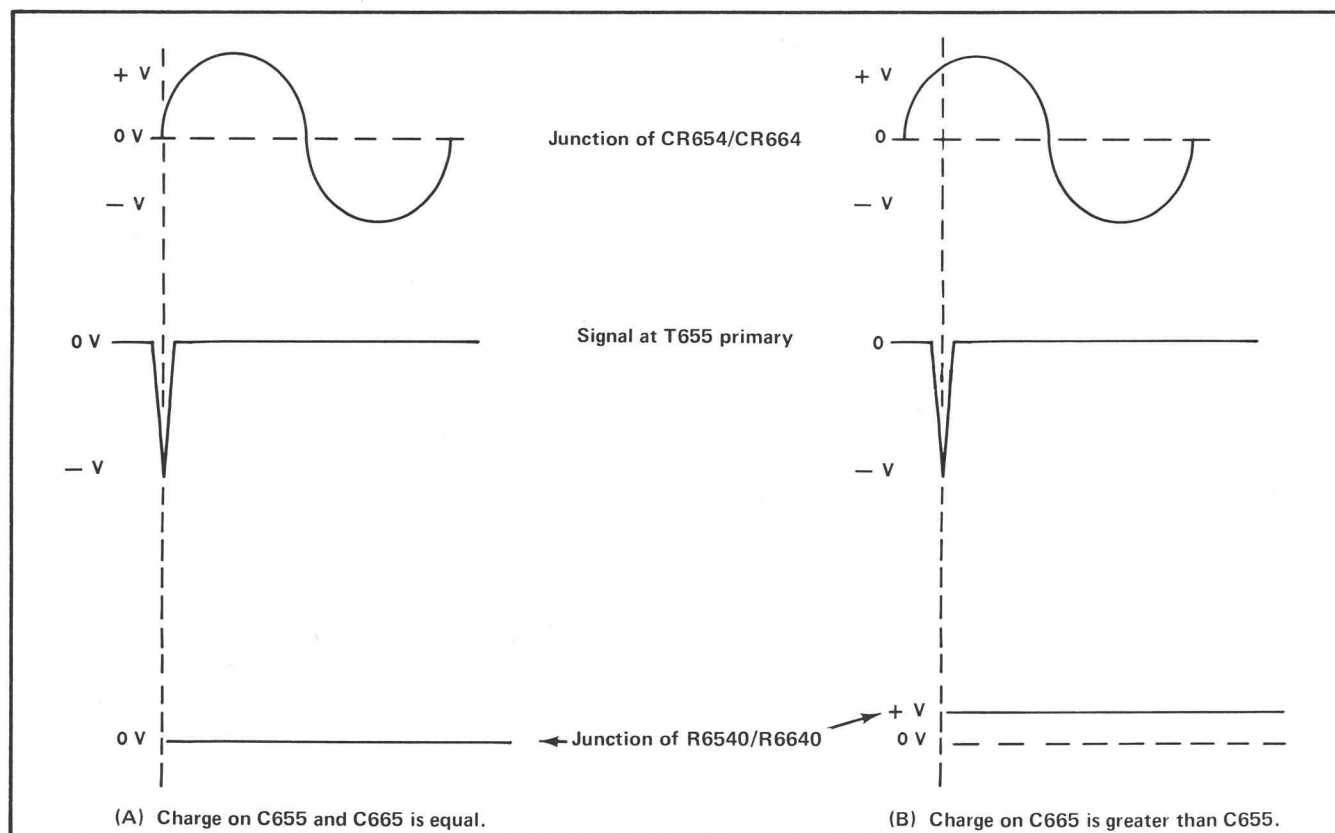


Fig. 3-9. (A) Action of Phase Lock Sampler at balance and (B) when unbalanced. In example (B), frequency of the Line Frequency Control Oscillator is too low and the level at the junction of R6540 and R6640 will cause the oscillator frequency to increase.

amplifier. Q673A is connected as a source-follower, driving the base of Q683. The inverted and amplified output signal at the collector of Q683 is applied to the voltage-variable capacitance (CR653) through R6630.

Q673B and Q693 serve as temperature compensation. C654 limits the bandwidth of the amplifier to stabilize the control loop, and R6631/C663 decrease the loop gain at medium frequencies to increase noise immunity.

Line Frequency Control Oscillator

The Line Frequency Control Oscillator, consisting of Y643, CR653, Q643 and Q644 is a modified Colpitts configuration. CR653 is a voltage-variable capacitance which alters the frequency of the oscillator in relation to the voltage from the Phase Lock Sampler circuit. A negative-going voltage at the cathode of CR653 increases the capacitance of the diode, lowering the frequency of the oscillator.

Q644 supplies the sustaining feedback to the oscillator circuit and serves as the output driving stage. Biasing is approximately Class B, with the collector output signal

being a clipped sine wave. Q643 provides additional gain, so that the overall gain can be degenerated, and thus more independent of transistor parameters.

The collector signal from Q644 triggers U636 in the Line Counter circuit.

Line Counter

The Line Counter circuitry, consisting of U615, U616B, U617, U625, U626, U627, U629, U636, U637 and U639, generates signals at the horizontal line rate and other harmonically related signals to drive the micrologic units which comprise the Line Detail Timing, Burst Logic, Comp Sync Logic, Bar Osc Start and Bar Preset, Horiz Drive Gate and Vert Preset circuits. Other output signals are used in the timing sequences for the Field Counter, Video Logic, VITS Logic, Crosshatch and Dot Generator and Line Blanking circuits.

U625, U626, U627, U629, U636, U637 and U639 are Type F μ L 923 JK Flip-Flop micrologic units connected as divide-by-two counters. See Integrated Circuits for a description of the operation of this configuration.

The first unit in the counter train (U636) is triggered by the Line Frequency Control Oscillator. The output signal at pin 5 is negative-going pulses at a rate of approximately 500 kHz. The output signals of each succeeding counter stage are at a rate which is one-half the input rate. The output of U626 is at the line rate (15,734 Hz). U625 is locked in the state which holds pin 7 low when the generator is in the external sync mode of operation. This allows the Phase Lock Sampler to run at the line rate.

Bar Osc Start and Bar Preset

The Bar Oscillator Start (U609) and Bar Preset (U607) circuits each consist of a four-input AND gate. The inputs are various timing signals from the Line Counter circuit.

Horiz Drive Gate

The Horiz Drive Gate circuit consists of Q610 and U601. U601 is a Set-Reset Flip-Flop (see Integrated Circuits). The set input is a line rate signal from the Line Counter. The H Sync Stop signal from the Line Detail Timing circuit is coupled through Q610 to pin 5 of U601 to serve as a Reset signal.

Comp Sync Logic

The Comp Sync Logic circuit consists of U603, U605, U606 and U613. U605 is a Set-Reset Flip-Flop with one set input and three reset inputs. The set input signals are the H Sync Start signal from Line Detail Timing and either Keyout from Field Logic or approximately 15 kHz from the Line Counter. The flip-flop is set at a 15,734 Hz rate except during the keyout, when it is set at a 31,468 Hz rate.

The reset inputs are the Equalizer Gate from Field Logic, Equalizer Stop from Line Detail Timing, H Sync Stop from Line Detail Timing, Keyout from Field Logic and the field sync reset derived from the Line Counter.

Burst Logic

The Burst Logic circuit consists of Q642, Q652, U602, U612B and U623.

U602 is a Set-Reset Flip-Flop which is set by a combination of the Burst Start signal from Line Detail Timing, the Keyout signal from Field Logic and a 15,734 Hz timing signal from the Line Counter.

The reset signal for U602 is coupled to pin 3 through U612B from Q642 (Burst Stop) in Line Detail Timing.

Field Preset Gate

U616A and U619 comprise the Field Preset Gate circuit. U616A serves to invert the "high" present at pin 1 whenever the REF switch is set to EXT. With the REF switch set to INT, a low is coupled to pin 1 of U616A. Inversion of the low to a high at pin 1 of U619 prevents the Field Preset Gate from functioning.

A 31,468 Hz signal from the Line Counter is coupled to pin 2 of U619. A negative-going pulse from the Ext Vert Sync peak detector is coupled to pin 5 of U619 (whenever external sync is supplied to the instrument). The pulse from the peak detector may be present during the transition from one line to the next. ANDing the pulse with the 31,468 Hz signal insures that the field preset signal will be generated only during a single line.

When pins 1, 2 and 5 of U619 are all low, a positive-going field preset pulse is present at pins 6 and 7 and thus at pin connector U.

Line Detail Timing

The Line Detail Timing circuit consists of U635B, U612A, Q621, Q622, Q662, Q672, Q682, Q691, Q692, CR621 and CR622. The circuit provides signals to the Comp Sync Logic circuit to control horizontal sync start and stop, equalizer stop, burst start-stop functions and a signal to permit adjustment of coincidence between the internal sync and an externally applied sync.

A symmetrical square wave at twice the horizontal line rate is coupled through U635B to Q621 and Q622, which are connected as a conventional Miller integrator. C631 and R6221 are the integrator timing components. Output of the integrator at the emitter of Q621 appears as a trapezoidal waveform. This signal is applied across resistive dividers in the base circuits of Q642 and Q652 in the Burst Logic circuit.

Fig. 3-10 illustrates the operation of the horizontal sync start circuit (Q691). Q642, Q652, Q662, Q672 and Q682 operate in a similar manner.

Q692 serves as a temperature compensation for the Miller integrator and Q642, Q652, Q662, Q672, Q682 and Q691.

FIELD TIMING



Circuits on the Field Timing board include the Field Counter, Field Logic, VITS Logic and Video Logic.

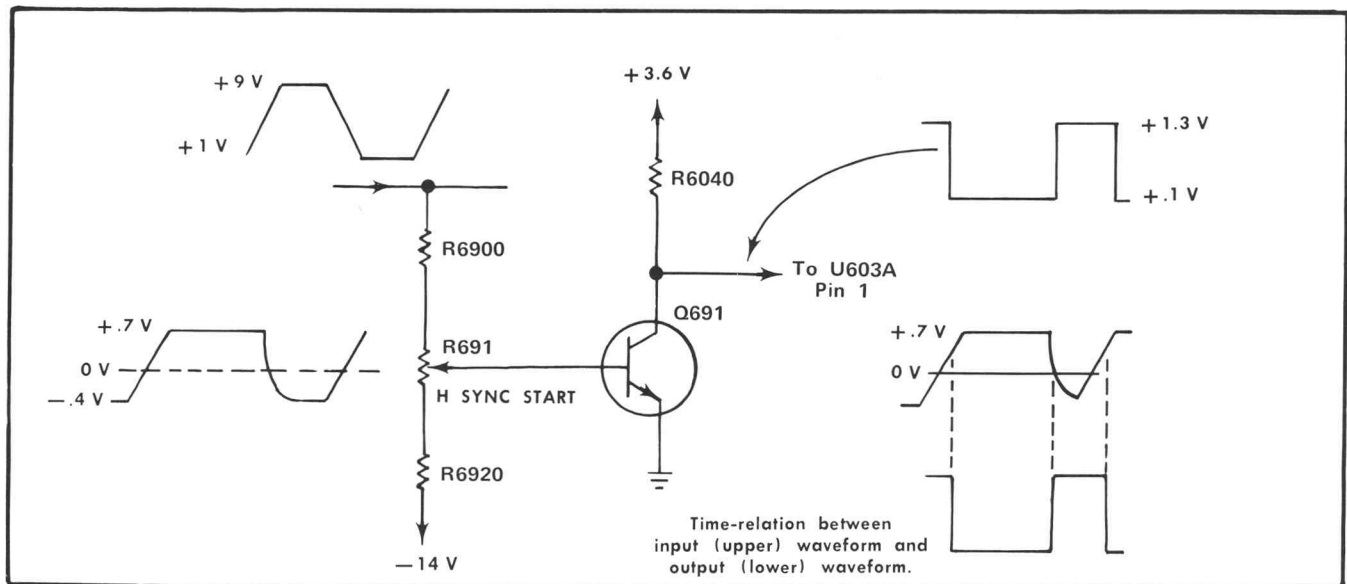


Fig. 3-10. H Sync Start circuit. Adjustment of R691 will select the point on the input ramp at which Q691 turns on, thus adjusting the time when the negative-going transition at the output occurs.

Field Counter

The Field Counter circuit consists of U301, U302, U304, U306, U308, U309, U321, U322, U324, U326, U328, U329 and U349A, Q311, Q312, Q314, Q316, Q317, Q318 and Q319.

The circuit is primarily a series of JK Flip-Flops, connected as a 525 state preset binary counter. The preset occurs at the beginning of video line 262. When Ext Comp Sync is applied, the Field Preset pulse serves as a second preset signal, being coupled by Q311 through Q319 to the appropriate counters to preset the counter to video line 7. A 31.25 kHz square wave from the Line Counter is coupled to pin 2 of U309 to start the counting sequence.

Output signals from the Field Counter are coupled to the VITS Logic, Field Logic and Video Logic circuits. Time relation of the output signals is shown on the pull-out diagram labeled Field Timing Details at the back of the manual.

Field Logic

The Field Logic circuit includes U336, U338, U341, U342, U344, U346A, U348, U349B, U361, U362, U364 and U372A.

The circuit is driven from various timing signals originating in the Field Counter circuit. Timing signals are combined in multiple-input AND gates to develop set and reset

input signals for various Set-Reset Flip-Flops. Generation of the Keyout signal will be described as an example.

When the three inputs of U342, (pins 1, 2 and 5) are all simultaneously low, the output (pins 6 and 7) goes high. Since the lows are simultaneous for only a short time, the output is a positive pulse. This positive pulse is coupled to the set input (pin 1) on U362, the Keyout Gate. When the gate is set, the 'one' output, pin 6, goes high (positive). Later, when pins 3 and 5 on U344B are both low, pin 6 goes high. The high is coupled to the reset input (pin 5) on U362, causing the 'one' output (pin 6) to return to low. The Keyout signal is therefore a positive pulse which starts when the set input of U362 goes high and ends when the reset input goes high. The Keyout signal is coupled to pin connector BA and thence to Comp Sync Logic and Burst Logic.

A negative keyout gate appears at the 'zero' output (pin 7) of U362. This signal is coupled to U372A to combine with the 'one' output of the Serration Gate, U364. When these two signals are low, a positive equalizer gate is generated at pin 7 of U372A.

Other signals generated in the Field Logic circuit include Vert Drive, Field Blanking and the set pulse for the Split Field Gate.

VITS Logic

The VITS Logic circuit includes U346B, U366, U368 and U369. U366 is connected as a Set-Reset Flip-Flop and the other micrologic units are negative-input AND gates.

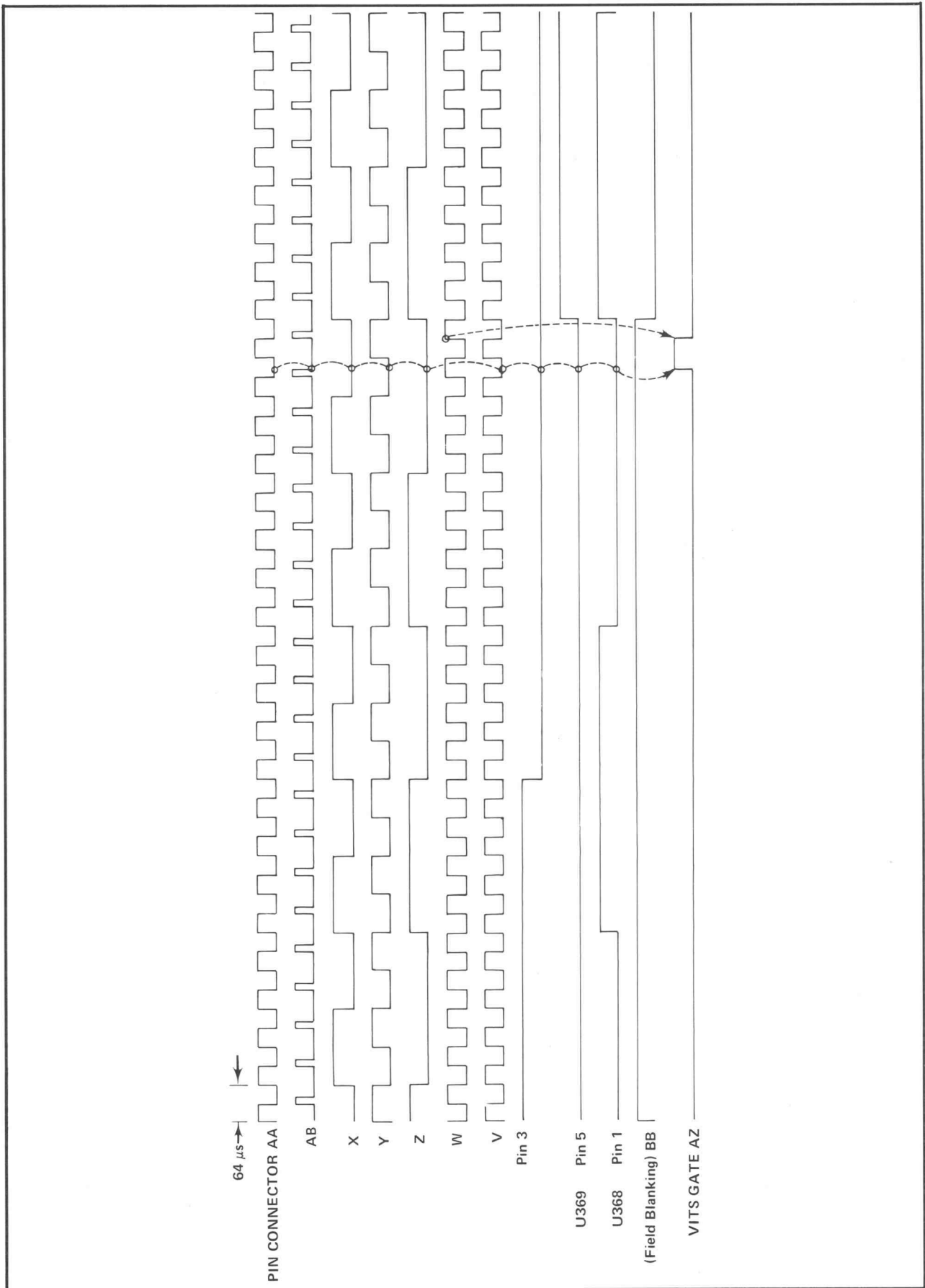


Fig. 3-11. VITS Logic input, output and related waveforms. VITS selected is Line 20, Field 2.

Fig. 3-11 illustrates the various signals related to VITS Logic in proper time-relation to each other. Note that nine different signals must be in the 'low' state to initiate the VITS gate.

Video Logic

The Video Logic section encompasses several related circuits which determine whether the line video will be STAIRCASE or COLOR BAR, and if COLOR BAR, whether the signal will be FULL FIELD COLOR BAR, —I, W, Q, B or SPLIT FIELD (a display of color bars followed by —I, W, Q, B bars). Selection of the VITS video signal (STAIRCASE or COLOR BAR) is also accomplished in this circuitry.

The Video Logic circuitry consists of U334, U371, U372B, U374, U376, U378, U379, U391, U392, U396, U399 and Q333, Q381, Q384, Q385, Q387, Q388, Q394, Q397 and Q398.

Since operation of the Video Logic circuits depends on settings of the VIDEO, BARS, SIGNAL and REF switches, a setting for each switch will be assumed and the circuitry will be explained under these conditions. Please refer to Fig. 3-12 for a simplified block diagram.

Assume the switches are set as follows:

Switch	Setting
VIDEO	COLOR BAR
BARS	FULL FIELD
SIGNAL (VITS)	STAIRCASE
REF	INT

The positive level into the Video Selector Drive provides an electronic switch to ground which is coupled to the VIDEO switch. This ground is also coupled to the VITS Color Bar Enable and VITS Staircase Enable stages. With the VIDEO switch in the COLOR BAR position, the ground is coupled to the Setup Field Drive, Color Bar Field Drive, I, Q Field Drive, I, Q Time Gate and Color Bar Time Gate circuits.

The Field Blanking signal is also coupled to the Setup Field Drive Circuit, so that a ground representing setup is coupled to pin connector H.

With the BARS switch set to FULL FIELD, the Split Field Gate is set to enable the Color Bar Field Gate. An enabling signal is also coupled to the Color Bar Time Gate, but this gate cannot function since another input (connected to the center contact of the BARS switch) is open.

The Field Blanking signal is also coupled to the Color Bar Field Gate, resulting in a positive output from the gate which provides drive to the Color Bar Field Drive circuit, and along with the ground from the Video Selector Drive circuit (via the VIDEO switch) forms a ground which is coupled to pin connector F.

With the VITS SIGNAL switch set to STAIRCASE, the VITS Enable Gate signal is coupled through the switch to the VITS Staircase Enable circuit. A video enabling signal is also coupled to the VITS Staircase Enable circuit from the Video Selector Drive circuit. When both of these signals are present at the input of the VITS Staircase Enable, a ground appears at pin connector M.

APL Logic

The APL Logic circuit includes U372B, U374, U376, U378 and U379, serving as a divide-by-five counter. U374, U376 and U379 are connected as JK Flip-Flops. (See Integrated Circuits.)

In the 50% position of the APL switch, pin 7 of U379 is grounded (low). In all other positions of the APL switch, pin 7 of U379 is low for one line, while pin 5 is low for four lines. Pin 7 is coupled to the Staircase Field Gate and pin 5 is coupled to the APL Field Gate. This circuit accomplishes the four lines of APL and one line of staircase display mode.

U372B supplies the preset pulse for the divide-by-five counter and also generates the reset signal for the Video Enable Gate.

BAR TIMING 2

Bar Oscillator

The Bar Oscillator circuit consists of Q206, Q216 and Q236. L217 and C218 are the oscillator tank elements. Q206 and Q216 are the active oscillator elements, with Q216 supplying the sustaining feedback. Q236 serves as the oscillator output stage. CR202 and CR206 in the tank circuit serve to limit the amplitude of oscillation.

Q216 and Q236 act as a current switch which changes state at the "0" crossing of the sine wave at the base of Q216, resulting in a square-pulse output across R234 in the collector circuit.

When the front-panel BARS switch is set to FULL FIELD, L217 and C218 determine the oscillator frequency, which is approximately 600 kHz.

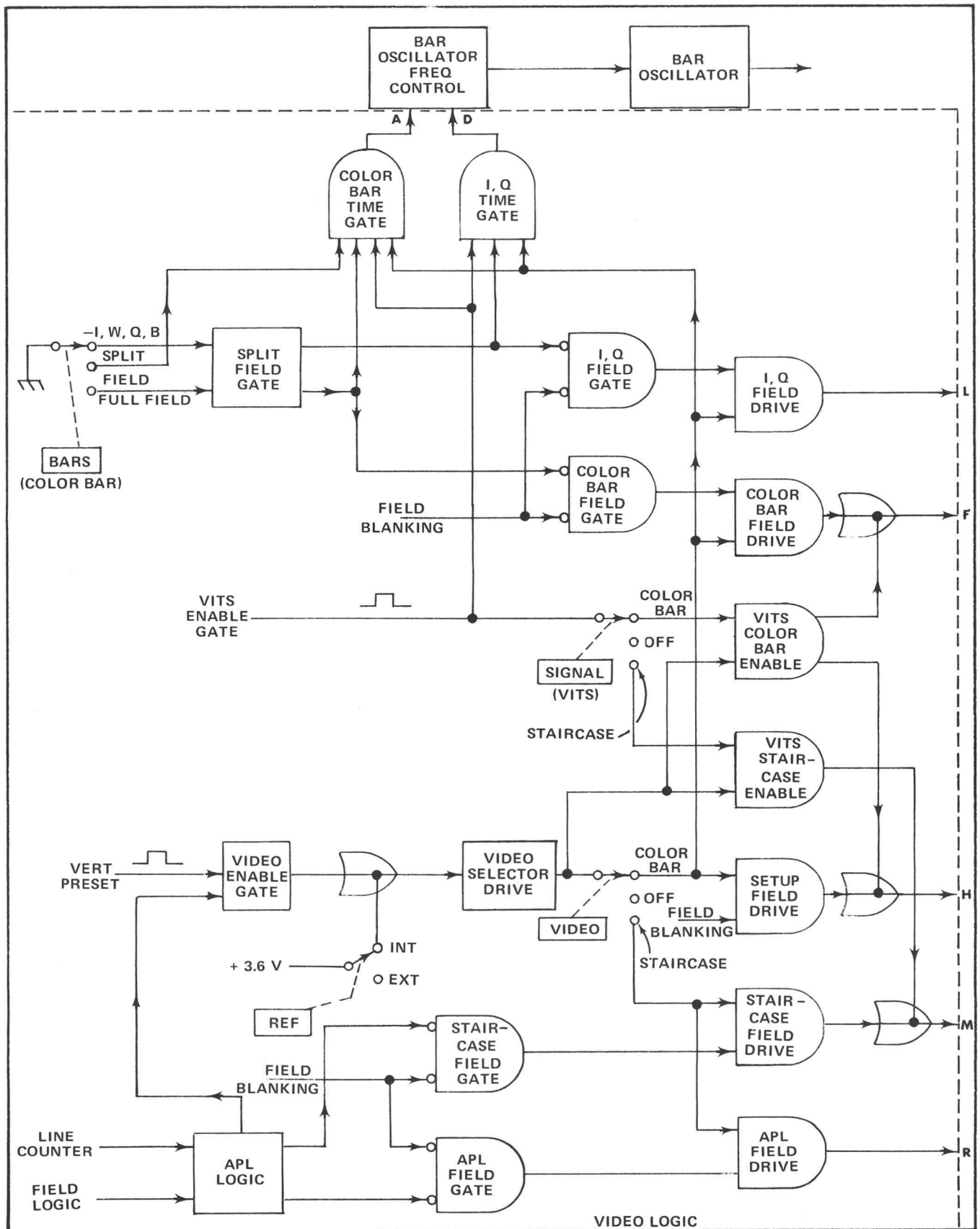


Fig. 3-12. Block diagram of Video Logic Circuits with logic symbols.

Bar Oscillator Frequency Control

When the BARS switch is set to -I, W, Q, B, the IQ Time Gate (positive) appears at pin connector AF, turning on Q228. This adds C224 and C227 across the tank, reducing the oscillator frequency to approximately 420 kHz.

With the BARS switch set to SPLIT FIELD, the Color Bar Time Gate signal appears at pin connector AG, turning on Q208 which adds C207 and C208 across the tank. The oscillator frequency is reduced to approximately 525 kHz. After about three quarters of the active video line, the Color Bar Time Gate is removed from pin connector AG and the IQ Time Gate appears at pin connector AF, reducing the oscillator frequency to approximately 420 kHz. See Fig. 3-13.

Q218 and Q238 serve to gate of Q208 and Q228 during line blanking. Since the end of line blanking is after the first cycle of the bar oscillator, the oscillator is not allowed to shift frequency until the blanking ends.

$\div 4$ Counter

The $\div 4$ Counter consists of U243, U245 and U247. U243 and U245 are JK Flip-Flops, each connected to count down by two. When the BARS switch is set to FULL FIELD, the 600 kHz output from the oscillator is used to trigger U243. This frequency is divided down to 300 kHz by U243 and then down to 150 kHz by U245. The output of the counter is coupled through U247 to the Luminance Delay and Color Bar Chroma Counter and Logic circuits.

Bar Oscillator Start-Stop Control

U253 and Q226 comprise the Bar Oscillator Start-Stop Control circuit. The oscillator is gated off during the interval between the end of the blue chroma color bar and one cycle before the start of the white level bar.

The Bar Osc Start signal appears at pin connector Z and is coupled to pin 1 on U253. The signal is a positive pulse which causes the output (pins 6 & 7) of U253 to go low. This cuts off Q226, permitting the bar oscillator to start. The oscillator starts instantly since R218 had been supplying the normal operating peak current through L217. The current is diverted to C218 when Q226 turns off, thus starting oscillation. The various timing signals from the Color Bar Chroma Counter & Logic circuit serve to hold Q226 at cutoff until the end of the blue chroma bar, at which time the output of U253 goes high, turning on Q226. With Q226 in saturation, the base of Q216 is nearly grounded, preventing oscillator action.

Luminance Delay

The Luminance Delay circuit consists of C252, R235, R238 and Q237. R235 is adjustable to provide the proper delay between color bar chrominance and luminance drives.

The pulse signals at pin 6 of U247 are differentiated in passing through C252, resulting in positive- and negative-going spikes as a signal applied to the base of Q237. R235 (Delay adjustment) varies the RC time constant of the waveform, thus setting the charge time of C252.

Q237 is normally biased at saturation. The negative-going excursions at the base bring Q237 into cutoff. Duration of cutoff is determined by the width of the negative-going spike at cutoff. See Fig. 3-14.

U258, U268 and U278 are triggered by a negative-going excursion. Duration of the positive pulse from Q237 determines the delay time at which the negative excursion occurs.

Color Bar Chroma Counter & Logic

U255, U257A, U265, U275 and U277 are the Color Bar Chroma Counter & Logic elements. U255, U265 and U275 are connected as JK Flip-Flops with preset inputs forming a synchronous counter. Operation of this configuration may be found described under Integrated Circuits. This circuit performs the counting and logic functions which convert the oscillator $\div 4$ signals into related green, red and blue chroma gate signals. Output from the Color Bar Chroma Counter & Logic circuit is coupled to the Staircase Timing Logic, IQ Chrominance Logic, IQ White Drive, Color Bar Chrominance Amplitude and Bar Oscillator Start-Stop Control circuits.

Color Bar Luminance Counter & Logic

U257B, U258, U267, U268 and U278 comprise the Color Bar Luminance Counter & Logic circuit. This circuit is similar to the Color Bar Chroma Counter & Logic circuit, except that luminance gates are generated corresponding to green, red and blue.

Output signals are coupled to the IQ Chrominance Logic, IQ White Drive, Color Bar Setup and Line Blanking and Color Bar Luminance Amplitude circuits.

IQ White Drive

The IQ White Drive circuit consists of U293A and U297. U297 is connected as a four-input AND gate, with the four inputs driven from various timing signals from the Color

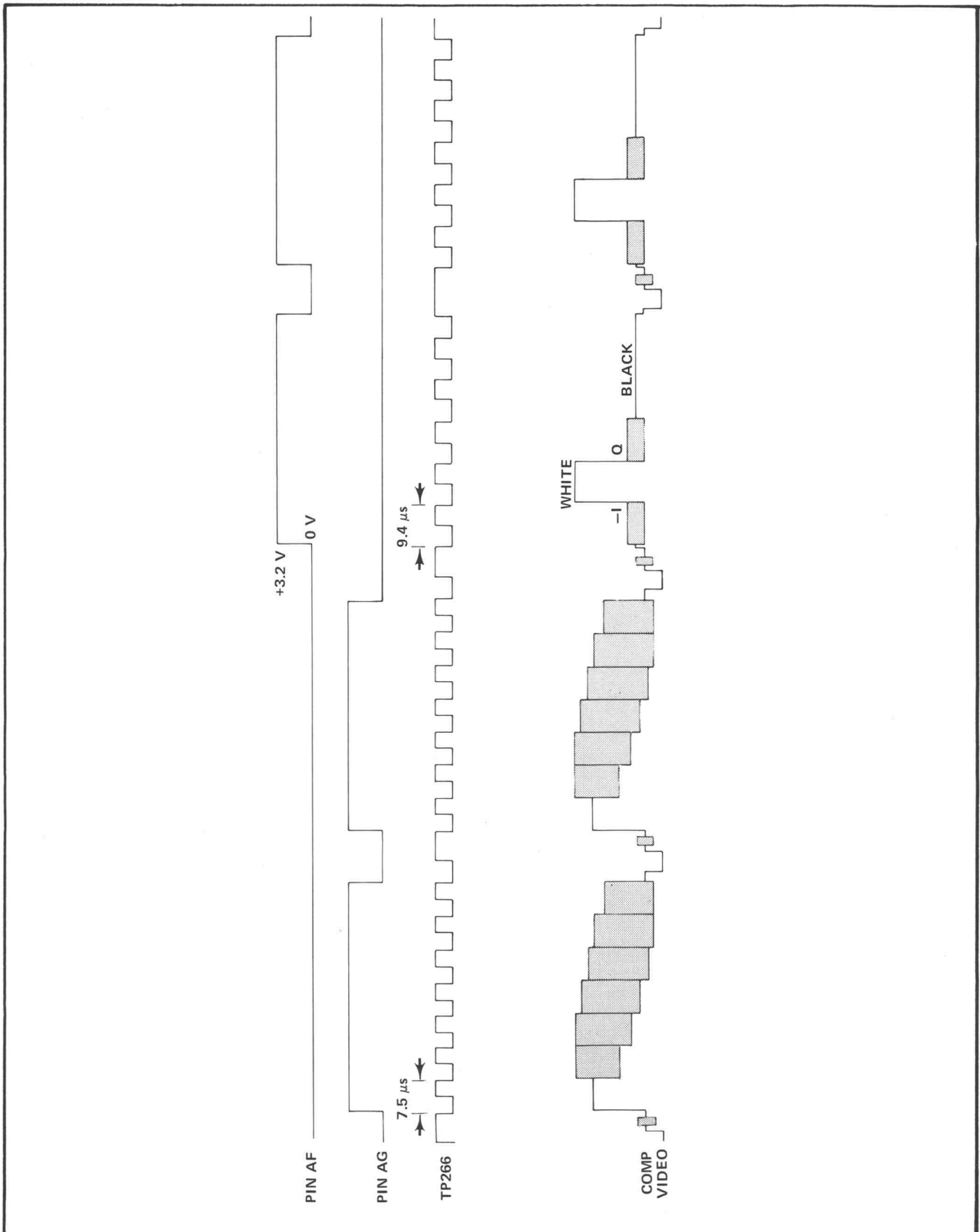


Fig. 3-13. Time-relation of waveforms to and from the Bar Oscillator in relation to the composite video signal in split field mode of operation.

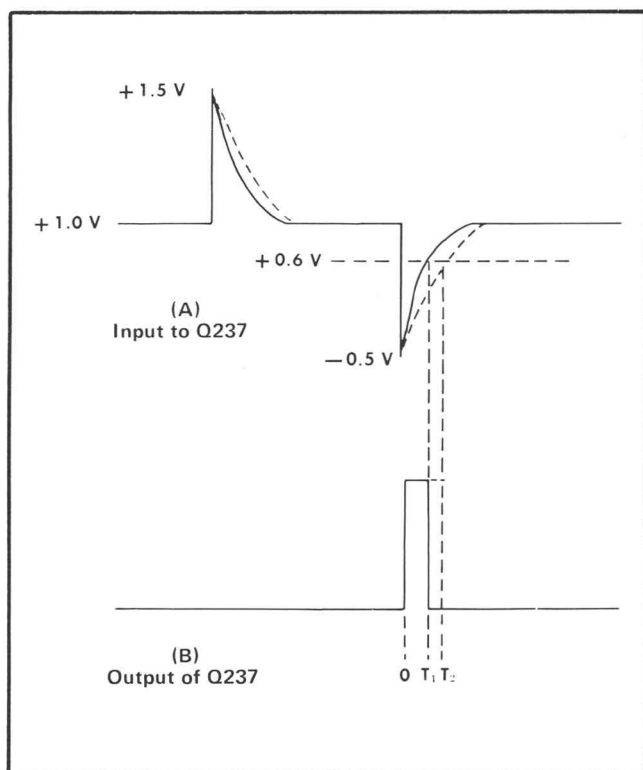


Fig. 3-14. Input and output waveforms for Q237. T_1 and T_2 are delay times with R235 set at each limit of adjustment.

Bar Chroma and Luminance Counter & Logic circuits. The output signal is coupled to the IQ White Reference Amplitude circuit.

Color Bar Setup & Line Blanking

U298, a Set-Reset Flip-Flop comprises the Color Bar Setup & Line Blanking circuit. The set signal originates in the Color Bar Luminance Counter & Logic circuit and the reset signal is a line rate pulse from the Line Counter circuit.

IQ Chrominance Logic

U263, U273, U293B and U295 perform the IQ Chrominance Logic functions. This circuit consists of several AND gates which combine timing signals from the Color Bar Chroma and Luminance Counter & Logic circuits to develop the I and Q chrominance gates.

IQ Chrominance Amplitude

The IQ Chrominance Amplitude circuit consists of Q251, Q252, Q261, Q262, Q281, Q282, Q291 and Q292. The I and Q drive gates from the IQ Chrominance Logic circuit are combined in this circuit to develop the I and Q + (R-Y), -(R-Y) and +(B-Y) signals. These signals are coupled

to the B-Y and R-Y Filters and thence to the appropriate modulators.

Color Bar and Setup Voltage Supplies

Q203, Q213, Q223 and Q233 serve as outputs for the voltages developed across the divider consisting of R201, R202, R213, R214 and R215. The output voltages are changed in accordance with the settings of the front-panel COLOR BAR AMPL and SETUP switches. The output voltages are coupled to the Color Bar Luminance Amplitude, Color Bar Chrominance Amplitude and IQ White Reference Amplitude stages.

STAIRCASE

5

Staircase Timing Logic

The Staircase Timing Logic circuit consists of U507, U508, U509, U517, U518, U519, U537, U538, U539, U547 and U548. This circuit is a series of 2-input gates and Set-Reset Flip-Flops which generate gating pulses of various widths.

The output signals are coupled to the APL Chroma, Staircase Chroma Amplitude and Staircase Luminance Amplitude circuits. (See Fig. 3-15 for output waveforms to Staircase Luminance Amplitude stages.)

Staircase Luminance Amplitude

Q514, Q516, Q523, Q524, Q525, Q526, Q533, Q534, Q535 and Q536 comprise the Staircase Luminance Amplitude stages.

Input signals to the Staircase Luminance Amplitude stages are shown in Fig. 3-15. Each waveform drives the base of a switching pair stage.

The switching pair stages are identical in configuration, so the circuit for Step 1 of the staircase (Q514 and Q516) will be described as an example.

The negative gate pulse arriving at the base of Q516 turns Q516 off, diverting the current through Q514. R562 in the common emitter circuit sets the magnitude of the current through Q514, thus setting the amplitude of the step.

At a later instant (approximately 6.5 μ s later), a negative gate pulse arrives at the base of Q525, diverting current through Q523. This current is added to the current from Q514, combining in the common collector circuit.

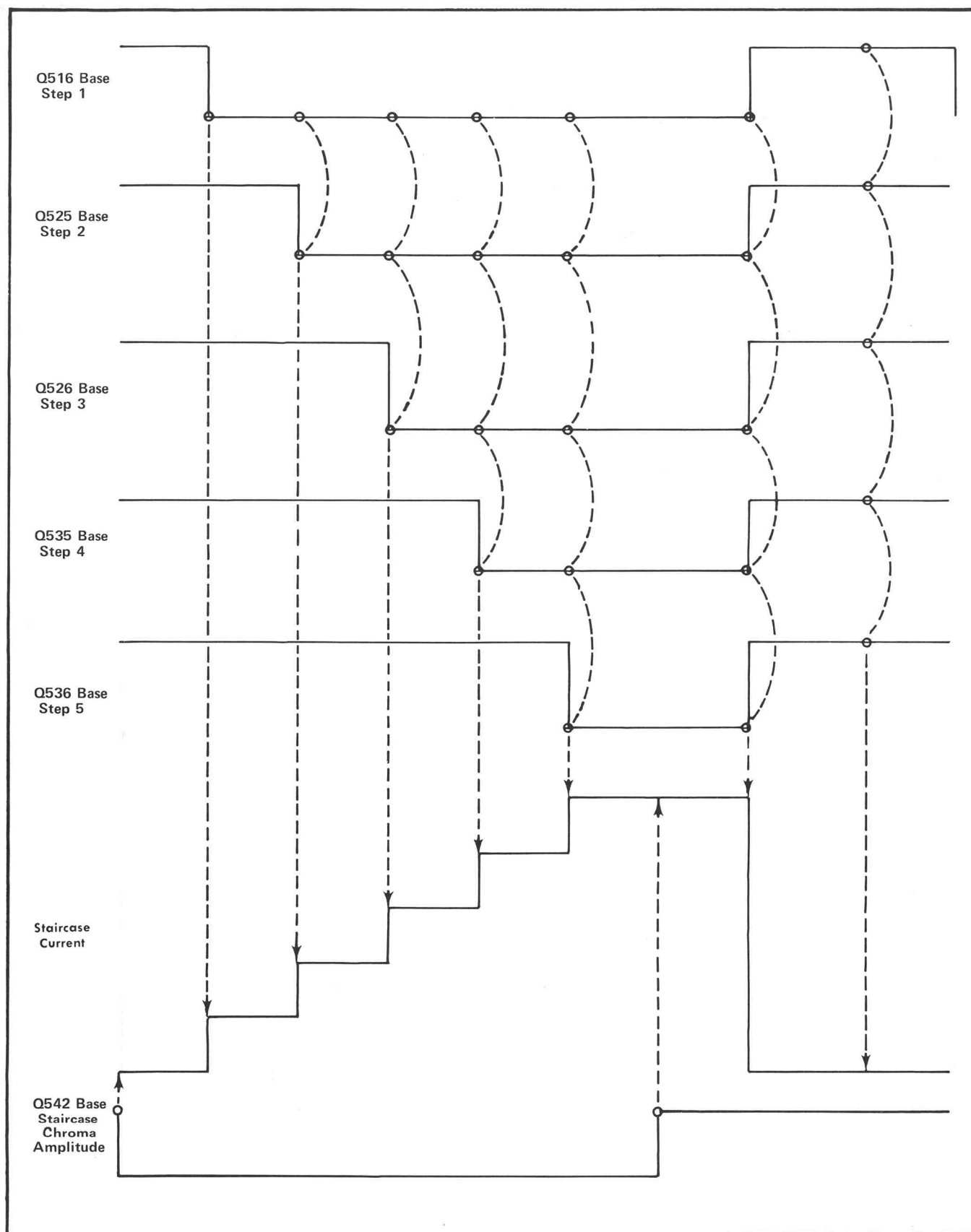


Fig. 3-15. Driving signals into Staircase Luminance Amplitude stages and resulting staircase current waveform at common collector output. Lower waveform shows time-relation of Staircase Chroma Amplitude gating signal.

Circuit Description—Type 140/R140

Fig. 3-15 illustrates the additive result of combining the individual step currents.

CR514, CR523, CR524, CR533 and CR534 couple the negative step currents through R542 to the +3.6 V supply except when the staircase field drive is present at pin connector AG. When the STEPS switch is in the down position, the step currents are coupled through these diodes at all times.

APL Amplitude

The APL Amplitude circuit consists of Q543, Q545 and the front-panel switch, APL (IRE LEVEL).

A negative line blanking signal is coupled to the base of Q545. The APL field drive, a negative gate, is coupled to the anode of CR545, preventing current flow through the diode during the gate. When the negative gate is not present, current flow from R545 is through the diode.

The line blanking signal diverts the current which normally flows through Q545 to Q543. Magnitude of the current is determined by the setting of S24 (APL), which selects the emitter series resistance.

The resulting current from Q543 is coupled through R535 to pin connector AL, combining with the staircase step currents.

Staircase Chroma Amplitude

Q532 and Q542 comprise the Staircase Chroma Amplitude circuit. This circuit is very similar to the APL Amplitude circuit previously described.

A negative gate from the Staircase Timing Logic circuit is coupled to the base of Q542, diverting the current from R551 and R561 through Q532.

When the 0° SUBCARRIER switch is in the "off" position (down), the common emitter current flows through CR542 and R542 to the +3.6 V supply. When the switch is in the "on" position (up), the staircase field drive signal at pin connector AK reverse-biases CR542, permitting the current to be diverted through Q532 during the gate.

The magnitude of the current is set by R561. The output current flows through R541 to pin connector AJ and

thence to the B-Y Filter and Modulator. See Fig. 3-15 for relation of staircase chrominance and steps.

APL Chroma

The APL Chroma circuit consists of Q501, Q502, Q503, Q511, Q512, Q513, Q522 and Q531.

This circuit is similar to Staircase Chroma Amplitude and APL Amplitude previously described.

In the OFF position of the 90° SUBCARRIER switch, current from R501 flows through CR511 and R512 to the +3.6 V supply and current from R502 and R504 flows through CR513 and CR522 and through R522 to the +3.6 V supply.

When the 90° SUBCARRIER switch is set to UNMOD, presence of the APL Field Drive signal at pin connector AE reverse biases CR511 for the duration of the negative gate. This permits current flow through Q511, providing a low-level offset chrominance during the APL lines.

When the 90° SUBCARRIER switch is set to MOD, presence of the APL Field Drive signal (negative gate) at pin connector AF reverse biases CR513 and CR522, permitting current flow through Q531 and Q522. Signals from the Staircase Timing Logic circuit divert current from Q503 and Q513 to Q531, while other Staircase Timing Logic signals divert current from Q502 and Q512 to Q522. Simultaneously, the negative gate at pin connector AF reverse biases CR521, changing the voltage division across the divider consisting of R512, CR510 and R521. This results in CR511 being reverse biased, permitting current flow through Q511.

Fig. 3-16 shows the time relation between the input gates, the output waveform of APL Chroma and the video output waveform.

Comp Sync Amplitude

Q544 and Q546 comprise the Comp Sync Amplitude circuit. This circuit is a current switch pair, similar to APL Amplitude, etc.

The composite sync signal at pin connector T is negative-going and diverts the current from Q546 to Q544. R567 sets the magnitude of the signal current. The adjusted signal is coupled through R544 to pin connector AM. When this signal is turned off, the current flows through Q546 continuously, diverting all current away from Q544. This

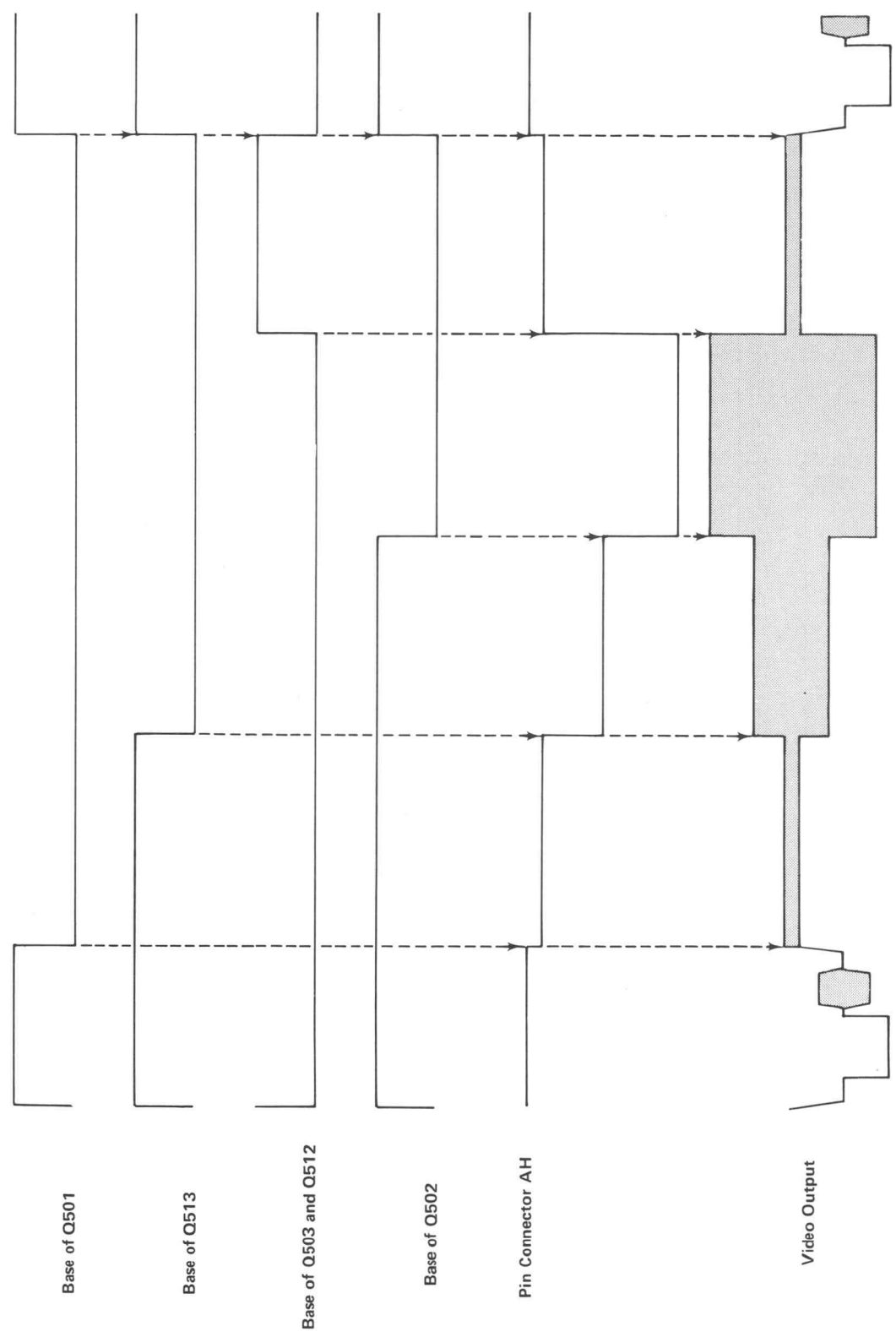


Fig. 3-16. Input and output waveforms for the APL Chroma circuit shown in relation to VIDEO OUT.

Circuit Description—Type 140/R140

maintains the output blanking level at 0 V instead of shifting it to sync tip voltage.

COLOR BAR DRIVE



Color Bar Chroma Amplitude

The Color Bar Chroma Amplitude circuit consists of Q400, Q402, Q403, Q406, Q407, Q408, Q420, Q422, Q423, Q426, Q427 and Q428. In this circuit, the amplitudes of the red, green and blue components of the $\pm(R-Y)$ and $\pm(B-Y)$ signals are adjusted to industry standards.

The circuit consists of 6 similar stages. Each of the three colors has an individual switching stage for the B-Y component and a stage for the R-Y component.

Since the stages are all similar, the blue amplitude-setting stage for the $+(B-Y)$ signal will be described as an example.

The blue chrominance drive signal from the Color Bar Chroma Counter and Logic circuit is coupled to pin connector S and thence to the base of Q428. The signal is negative in polarity, driving Q428 into cutoff during each pulse. The current that had been flowing from R418 and R419 through Q428 is now diverted to flow through Q408 and R409. R419 is adjustable, permitting calibration of the $+(B-Y)$ signal magnitude. The signal is coupled through R409 (a parasitic suppressor) to pin connector AB and thence to the B-Y Filter.

When the front-panel COLOR BAR AMPL switch is set to 75%, 10% SETUP, the Color Bar Voltage Supply is at -9.7 V. The emitter circuit of Q428 and Q408 is therefore returned through R418 and R419 to -9.7 V, which sets the current through this divider to correspond to 75% amplitude. The 0.6 V supply temperature compensates the V_{be} of Q408.

When the COLOR BAR AMPL switch is set to 100%, 10% SETUP the Color Bar Supply Voltage becomes -12.9 V, thus increasing the current through R418 and R419 to correspond to 100% amplitude.

R428 and C427 introduce a signal delay to permit time-coincidence adjustment of the $+(B-Y)$ signal to the $-(B-Y)$ signal.

During the vertical blanking interval, the drive to pin connector M is an open circuit, allowing CR406 to be forward biased and thus diverting the blue channel current

through CR406 and R427. During the active video portion of the field, the Color Bar Field Drive signal at pin connector M (a transistor saturated to ground) reverse biases CR406, permitting the blue chrominance amplitude signal to flow through Q408.

From pin connector S, the blue chroma drive signal is also coupled to the base of Q420 and thence through a circuit similar to that just described to form the $-(R-Y)$ component of the blue chroma amplitude signal.

Burst Amplitude

Q404, Q424 and CR425 comprise the Burst Amplitude circuit. This circuit consists of a switching pair stage which is very similar to the Color Bar Chroma Amplitude stage previously described.

The Burst Flag (a negative gate) at pin connector N is coupled to the base of Q424, thus diverting the current that had been flowing through Q424 to flow through Q404. R414 calibrates the burst amplitude via the magnitude of the current which flows through Q404. The signal current is then coupled through R408 (a parasitic suppressor) to pin connector AA to form part of the $-(B-Y)$ signal.

When the front-panel BURST switch is in the "off" position (down), the burst signal current is diverted through CR425 to the $+3.6$ V supply.

MODULATOR



Subcarrier Limiter & Modulator Driver

Q114 through Q118 comprise the Subcarrier Limiter and Modulator Driver circuit. This circuit serves to assure that the modulator is always driven with the same amplitude of subcarrier signal, whether the subcarrier is supplied from an internal or external source. Also, the circuit corrects for any lack of symmetry in the input waveform to assure that the modulator is driven with a balanced input waveform.

The input stage, Q114 with diodes CR104 and CR105, limits the peak-to-peak amplitude at the collector of Q114 to approximately 1.1 volts. CR104 limits the positive excursions and CR105 limits the negative excursions.

The subcarrier signal, now roughly square wave in shape, is coupled through C105 to the base of Q115. Q115 and Q116 convert the signal into a push-pull signal by common-emitter coupling. C115/R106 and C116/R116 integrate the

input square wave, changing the wave-shape to triangular. The triangular-shaped signal is AC coupled through C117 and C118, resulting in a drive signal which is symmetrical in duty cycle. In other words, the duration of the positive and negative excursions (from 0 volts) is equal.

The amplitude of the triangular signal at the bases of Q117 and Q118 is sufficient to drive each side to cutoff and saturation, causing a square wave signal across the input windings of T127. The square wave frequency is at the sub-carrier rate.

0–180° Phase Shifter

The 0–180° Phase Shifter circuit includes U102, Q111, Q112, Q113, Q122, and Q123. This circuit provides selection of the phase of the R-Y component.

U102 is connected as a JK Flip-Flop and is triggered by the trailing edge of the inverted Bar Preset signal (via Q113) at the line rate.

When the R-Y PHASE switch is set to 90° (normal), +3.6 V is applied to pin 1 of U102, allowing the flip-flop to be triggered into only the pin 7 high-pin 5 low state. When the switch is set to 270°, the flip-flop is allowed to be triggered only to the opposite state, with pin 7 low and pin 5 high. The ALT position of the R-Y PHASE switch allows U102 to be triggered into opposite states (alternately) at the line rate.

Q111 and Q112 serve as push-pull drivers for Q122 and Q123, which, in turn, drive the primary of T144. For any given line, one side (for example Q122) will be in saturation while the other side (Q123) is cut off. No collector supply as such is required for Q122 and Q123 since sufficient base drive is available for the transistors to function in reverse. That is, the collector acts as an emitter and vice versa.

(R-Y) (B-Y) Quad Phase

The subcarrier signal is coupled from T127 through the (R-Y) (B-Y) Quad Phase, C127, L126 and C125 and through C124 to the center tap on T144. In passing through the (R-Y) (B-Y) Quad Phase circuit, the subcarrier signal is shifted 90° in phase.

During a line where Q122 is in saturation (270° phase), the subcarrier signal current flows through half of T144 primary and Q122. When Q123 is in saturation (90° phase), the subcarrier signal current flows through the other half of T144 in the opposite direction and through Q123. Therefore, when the R-Y PHASE switch is set to ALT, the sub-

carrier signal appearing across the secondary of T144 is shifted 180° in phase each line.

±(B-Y) and ±(R-Y) Filters

L183, C182 and C193 comprise the +(R-Y) Filter. The –(R-Y) Filter consists of L163, C162 and C173.

The characteristics of the two filters must be made identical since the composite (R-Y) signal is formed after the filters in differential stage, Q153A & B. Separate handling of the + and – (R-Y) components is required in order to achieve the excellent carrier balance stability of the Type 140.

Bandwidth of each filter is approximately 1.5 MHz, preventing the R-Y components from exceeding the 3.58 MHz modulated frequency. The +(B-Y) Filter, L187 and the –(B-Y) Filter, L167 are identical in operation to the R-Y filters.

When the front-panel controls are set to provide a full field color bar signal for composite video, the +blue signal component is coupled to pin connector O to become the +(B-Y) component. The –red, green and burst components at pin connector P form the –(B-Y) component. At pin connector B the –blue and green signals form the –(R-Y) component and the +red signal at pin connector H forms the +(R-Y) component.

When a modulated staircase or –I, W, Q, B signal are selected, other modulating signals are coupled in as indicated to form the R-Y and B-Y components.

R-Y and B-Y Double Balanced Modulators

Except for the phase-shifting of the R-Y axis with respect to the B-Y axis, the two modulators are identical in operation. A description of the B-Y Modulator will be given as an example.

The B-Y Modulator circuit consists of Q146, Q156, Q157A, Q157B, Q166, Q176, Q177 and Q178.

The modulator stage, Q146, Q156, Q166 and Q176 is connected in a double-balanced configuration. This type of modulator cancels out the modulated carrier and the modulating signal, retaining the sidebands.

The subcarrier signal (3.58 MHz) across the secondary of T136 drives the bases of Q146, Q156, Q166 and Q176. Q157A and Q157B provide a differential signal current to

Circuit Description—Type 140/R140

the emitters of the modulator stage depending on the drive conditions. For example, if a +phase signal is required, a negative signal current is delivered through the +(B-Y) Filter and its terminating grounded base stage (Q177) to the 1 k Ω load of R168. This develops a negative voltage at the base of Q157A, decreasing its collector current while increasing Q157B's collector current, since a near-constant current is delivered to the junction of R157 and R167 through R143.

Q166 and Q176 switch the current from Q157A alternately from one end of T174 to the other at a 3.58 MHz rate, thus developing a 3.58 MHz square wave across the reflected load of R174.

Q146 and Q156 switch the current from Q157B alternately from one end of T174 to the other also, but 180° out of phase with the current delivered by Q157A. Thus, if the currents from Q157A and Q157B are equal, the current square waves in T174 will cancel. If Q157B delivers a greater current than Q157A, the signal developed across T174 will be proportional to the current difference and positive in polarity; that is, 0° in phase.

R148 and C157 balance the plus and minus B-Y driver stages to minimize any residual subcarrier component. These are adjusted for minimum chrominance output when R-Y and B-Y are turned off (see Performance Check/Calibration section).

Bandpass Filter

The modulated output appears across T174 and is coupled through the Bandpass Filter, L176 and L184, via a short length of 50 Ω coaxial cable which also serves as a low pass filter to the Chroma Output Amplifier.

The Bandpass Filter has an arithmetically symmetrical response with a center frequency of 3.58 MHz. Bandpass of the filter is approximately 1.5 MHz.

This bandwidth in conjunction with the 1.5 MHz R-Y and B-Y filters provides a chrominance bandwidth of approximately ± 1 MHz.

VIDEO OUT



The Video Out diagram contains several circuits which will be individually described. These circuits include the Color Bar Luminance Amplitude, I, Q White Reference Amplitude, Wide Band Filter, Narrow Band Filter, Lumi-

nance Output Amplifier, Chrominance Enable and Chrominance Output Amplifier.

Color Bar Luminance Amplitude

The Color Bar Luminance Amplitude circuit includes Q434, Q436, Q441, Q443, Q445, Q450 through Q456, Q463 and Q465.

The red, blue and green amplitude-setting stages, white reference and setup level stages are all similar in operation, so a description of the green amplitude-setting stage will serve as an example.

The green luminance signal (negative polarity) is coupled from pin connector AS to the base of Q463, turning Q463 off and diverting the current through Q465. Amplitude of the current is determined by the setting of R454. C465 compensates for unequal delays in the rise and fall of the signal.

When the front-panel Y switch is set to the off position (down), the signal current is shunted to the +3.6 V supply through CR462, R452 and R462. With the Y switch set to 'on' (up), the color bar field drive signal (delayed by R452 and C452 to match the chroma delay) appearing at pin connector AT reverse biases CR462, permitting the normal signal current to flow through Q465. During the vertical blanking interval, (except during a color bar VITS signal) CR462 is forward biased, diverting the signal current to the +3.6 V supply.

The additional current for the 100% supplied by R443 and R455, is diverted through Q455 to become signal current only when the following 5 conditions are satisfied: (1) Q453 must be off (2) Q451 must be off (3) Q452 must be off (4) the inhibit drive (only in SPLIT-FIELD) must not be present and (5) the white drive via the WHITE REF, 75% AMPL and Y switches must be present. R443 adjusts the current to the proper white reference amplitude. Currents from the red, blue and green amplitude stages, white reference amplitude and setup amplitude stages are coupled together through R456 to the emitter of Q446.

When the front-panel AMPL and SETUP switches are set to 75% and 10% respectively, the color bar voltage (CB V) in the emitter circuits of the red, blue, green and white reference amplitude stages is set to -9.7 V. With the AMPL and SETUP switches set to 100% and 10% respectively, the color bar voltage is changed to -12.9 V, increasing the emitter currents to correspond to 100% amplitude.

When the front-panel SETUP switch is set to 10%, -12.3 V from the Setup Voltage Supply is coupled from pin con-

necter AJ to the base of Q441, setting the current to correspond to a 10% setup level. With the SETUP switch set to 7.5% or 0%, the voltage at pin corrector AJ becomes -12.7 V or -13.8 V respectively, causing the setup current to correspond to 7.5% or 0%. Q450 turns off at 0 setup allowing the current through R431 and CR441 to reverse bias Q441, which insures no current flow.

The composite sync signal is coupled from pin connector H to the emitter of Q446, and along with the color bar luminance amplitude signals, is coupled through the Wide Band Filter.

I, Q White Reference Amplitude

Q431, Q433 and Q435 comprise the I, Q White Reference Amplitude circuit. This circuit is very similar to the Color Bar Luminance Amplitude stages previously described except for the variable voltage supplied by Q431 at the negative end of the current-setting resistors R444 and R434. The I, Q white line drive signal at pin connector AG biases Q433 at cutoff during the white bar portion of the -I, W, Q, B signal, diverting the current through Q435. R434 in the common-emitter circuit sets the magnitude of the current, providing a calibration adjustment.

Q431 couples the setup supply voltage to the emitter circuit, which maintains the proper 100% reference current at all set-up levels.

The I, Q White Reference signal is coupled through Q435 and R436 to the emitter of Q447. When the VIDEO switch is set to MOD STAIRCASE, the staircase luminance signal is coupled from pin connector J to the emitter of Q447.

Wide Band Filter

The color bar luminance levels and composite sync signal are coupled through Q446 to the Wide Band Filter, L456 and L466. The output impedance of Q446 is high, serving as a constant-current signal source to drive the filter. R457 is the termination for the filter. The filter has a risetime of 115 ns and is \sin^2 shaped.

Response of the wide band filter has been selected to provide color bar luminance steps extending to the allowable system bandwidth.

Narrow Band Filter

The I, Q white reference level and staircase luminance signals are coupled through Q447 to the Narrow Band Filter, L458 and L468. The filter has a risetime of 260 ns

and is \sin^2 shaped. The function of the filter is to minimize step harmonics which may fall in the chrominance band.

Luminance Output Amplifier

The Luminance Output Amplifier, consisting of Q476, Q477, Q478 and Q487, is an operational amplifier circuit. Characteristically, the input impedance is very low and the signal voltage at the emitter of Q478 will be only a few millivolts in amplitude.

R_f for the amplifier consists of R467 and R499. Adjustment of R499 sets the gain of the stage, providing a calibrated luminance amplitude at the output connector.

R478 provides adjustment of the DC input current thus determining the output DC level.

Q476 sets the emitter voltage of Q477 and acts as a temperature compensation. CR479 in the base circuit of Q478 is also a temperature compensation.

The amplified luminance signal is coupled through R488 and R497 to the rear- and front-panel COMP VIDEO connectors.

K495 connects the output signals from the luminance and chrominance output amplifiers to the output connectors when the instrument is energized. When the instrument is turned off, contacts on K495 remove the connections between the output amplifiers and the output connectors and then connect the output connectors through R487 and R496 to ground. This assures that any cables connected to the output connectors are terminated in 75 ohms whether the instrument is turned on or off.

Chrominance Enable

The Chrominance Enable circuit includes Q471, Q481 and Q491. When a subcarrier signal is present at the subcarrier output amplifier, the signal is detected by CR1156 (on the Subcarrier Osc. & Output Amplifier diagram), resulting in a negative voltage at pin connector AW and the base of Q471. This negative voltage forward biases Q471 into saturation. With Q471 in saturation, the divider consisting of R461, R471 and R491 reverse biases Q481. Q491 is then reverse biased through R490, so no subcarrier signal current can flow through C491 and Q491 to ground. C491 is a 3 volt capacitor which supplies leakage current to maintain the collector-base junction of Q491 in a reverse bias condition.

When there is no subcarrier signal present at the subcarrier output amplifier, the voltage at pin connector AW is

Circuit Description—Type 140/R140

near zero and Q471 is cut off. Q481 becomes forward biased, which causes Q491 to go into saturation. With Q491 in saturation, any signal (noise) at pin connector BE is shunted to ground through C491 and Q491.

Chrominance Output Amplifier

The Chrominance Output Amplifier is an operational amplifier consisting of Q473, Q474, Q475 and Q484. This circuit is very similar to the Luminance Output Amplifier previously described.

The chrominance signal at pin connector BE is coupled to the emitter of Q473 through R481, which serves as R_i for the amplifier. R_f consists of R473 and R482. Adjustment of R482 sets the gain of the stage to provide a calibrated chrominance amplitude at the output connectors.

Luminance and chrominance signals are combined into a composite signal at the output connectors. The parallel combinations R488/R494 and R495/R497 each provide an output impedance of 75 Ω at each respective output connector.

Separate output amplifiers for luminance and chrominance are used in order to minimize distortions such as differential phase and differential gain. If a common output amplifier were used, changes in the luminance signal could cause changes in the instantaneous operating level of the amplifier stages, introducing differential distortion to the chrominance signal.

OUTPUT AMPLIFIERS

9

The Output Amps board contains the output amplifiers for the COMP BLANKING, COMP SYNC, FIELD DRIVE, LINE DRIVE and BURST FLAG signals available at front and rear panel connectors.

These five amplifiers are nearly identical in operation, making it possible to use one which is working properly as a reference when trouble-shooting another which is defective.

A description of the Comp Blanking Output Amp follows. This description may be used to gain an understanding of the operation of the other four amplifiers.

Comp Blanking Output Amp

The Comp Blanking Output Amp includes Q980, Q982, Q990, Q992, Q994, Q996 and Q998.

The composite blanking signal from the Comp Blanking Logic circuit is coupled to pin connector AE, and through R982 (a VHF oscillation suppressor) to the base of Q982. At pin connector AE, the composite blanking signal is positive in polarity with an excursion from approximately 0 V to +2 V.

Q980 and Q982 operate as a switch pair. The positive signal at the base of Q982 drives Q982 into cutoff, diverting the current flowing in R981 through Q980.

The relatively high output impedance of Q980 serves as a constant current source to drive the filter, L984 and L985. The filter limits the risetime of the composite blanking signal to prevent ringing in transmission cables.

Q990, Q992, Q994, Q996 and Q998 form an operational amplifier. R990 is the feedback resistance. The input current is determined by R981. Q996 and Q998 are parallel-connected to supply the negative-going drive to the two COMP BLANKING outputs. Q994, an NPN, provides current for reverse terminating any negative pulses which may appear at the output terminal due to unterminated coaxial cables.

R992, R993, R994, C992 and C994 automatically set the current in Q994 and Q996 at approximately 2 mA, while allowing the amplifier to deliver a positive pulse current of approximately 50 mA.

Q964 is common to all five output amplifiers, supplying temperature-compensated base bias for Q900, Q920, Q940, Q960 and Q980.

CROSSHATCH and DOT GENERATOR

7

The Crosshatch and Dot generator circuit develops the CONVERGENCE PATTERN output signal. The diagram shows 3 basically separated circuits, the horizontal and field generators and the output amplifier.

Horizontal Timing Generator

The Horizontal Generator includes Q751, Q752, Q761, Q762, Q776, Q783, Q784, Q786, Q793, Q794, Q796, U775, U785A, and U785B.

During horizontal unblanking time, Q761 is biased off and its collector is at a positive level determined by the temperature compensated constant current from Q751

through the HORIZONTAL POSITION control. C761 is charged to this level.

Upon arrival of the positive-going line blanking signal at its base, Q761 saturates, reverse biasing Q762 with the preset voltage on C761. Q752 is a constant-current source which discharges C761 at a linear rate. Q762 turns on when the voltage on C761 reaches its V_{be} . Therefore, the HORIZONTAL POSITION control setting determines how long Q762 is cut off after the arrival of the line blanking signal. CR762 prevents Q762 from reaching saturation during conduction, so that turn-off is rapid.

With Q762 biased off, its collector goes positive, forward biasing Q793. Q793 and R793 present a low impedance shunt across the oscillator tank (L791 and C792), which prevents oscillation, while setting the proper current through L791 for an instant start of oscillation.

When the positive gate at the collector of Q762 ends, Q793 becomes reverse-biased, eliminating the oscillator tank shunt loading. Oscillation commences, with sustaining feedback coupled through Q794 to the base of Q783. CR781 limits the magnitude of the negative excursions at the output of the oscillator tank. CR791 serves as a temperature compensation for the circuit.

The duration of the positive gate from Q762's collector is always less than the period of line blanking, so that the oscillation commences before the end of line blanking. When oscillation starts, vertical crosshatch lines or dots are generated. Since the HORIZ POSITION control setting determines when the oscillation starts with relation to line blanking, this will also determine the horizontal position of the crosshatch lines or dots during the active part of the television line.

Q784 and Q794 are connected as a switch, with the emitter currents flowing through R794. R764 and C783 form a decoupling network for the +10 V supply. During the negative half-cycle of oscillation, current is increased through Q794 shutting off Q784. During the positive half-cycle of oscillation, Q784 is conducting while Q794 is off. At the collector of Q784, the signal is basically a square wave in shape, with the negative-going excursions serving as a trigger signal for U775.

U775 is connected as a preset triggered counter stage. The counter is preset by the positive gate at the collector of Q762. This gate is coupled through R772 to pin 6 of U775. The counter divides the input trigger rate by two. That is, the output signal at pin 5 or pin 7 is at one-half the input trigger rate at pin 2. The pin 5 output signal is coupled to

U785A to develop the horizontal timing component of the dot pattern. The negative gate at pin 5 is also coupled back through R754 to the base of Q784, lengthening the time during which pin 5 is held low. The output signals at pins 5 and 7 are non-symmetrical, with the negative gate at pin 5 longer in duration than the negative gate at pin 7. This difference is necessary to achieve proper interlace of dots and crosshatch signals when operating the BOTH position of the DISPLAY switch.

C764 and R774 (base of Q784) provide a time-constant which prevents the leading edge of the positive gate from pin 5 of U775 from initiating a double trigger.

With the DISPLAY switch set to BOTH, the negative gate at pin 5 of U775 is inverted by U785A. The resulting positive gate is differentiated by C785 and R765, giving a narrow positive spike at the base of Q786. This spike reverse-biases Q786 for 350 ns, providing a negative pulse at the collector and TP766.

The negative gate at pin 7 of U775 is inverted by U785B, resulting in a positive gate at the base of Q796. The positive gate thus appearing at the emitter of Q796 is differentiated by C795 and R775. The 250 ns positive pulse is coupled through Q776, a grounded base stage to TP776.

Refer to Fig. 3-17 for time-related waveforms in the Horizontal Generator.

When the DISPLAY switch is set to CROSSHATCH, +3.6 V is coupled to pin 1 of U785A, preventing generation of the dot pattern. In the DOT position of the DISPLAY switch, +3.6 V is coupled through CR784 to pin 5 of U785B, preventing generation of the vertical crosshatch component. +3.6 V is also coupled through CR794 to pin 3 of U732, preventing generation of the horizontal crosshatch component.

The CROSSHATCH switch disables the horizontal crosshatch generator when set to VERT by coupling +3.6 V to pin 3 of U732. In the HORIZ position, +3.6 V is coupled to pin 5 of U785B, disabling the vertical crosshatch generator.

Field Timing Generator

The Field Timing Generator includes Q704, Q705, Q714, Q715, U711, U712, U721 through U725, U731, U734, U741, U742, U743A, and U744.

The circuit is basically a counter which counts down from the line blanking signal at a ratio of 35:1. The counter

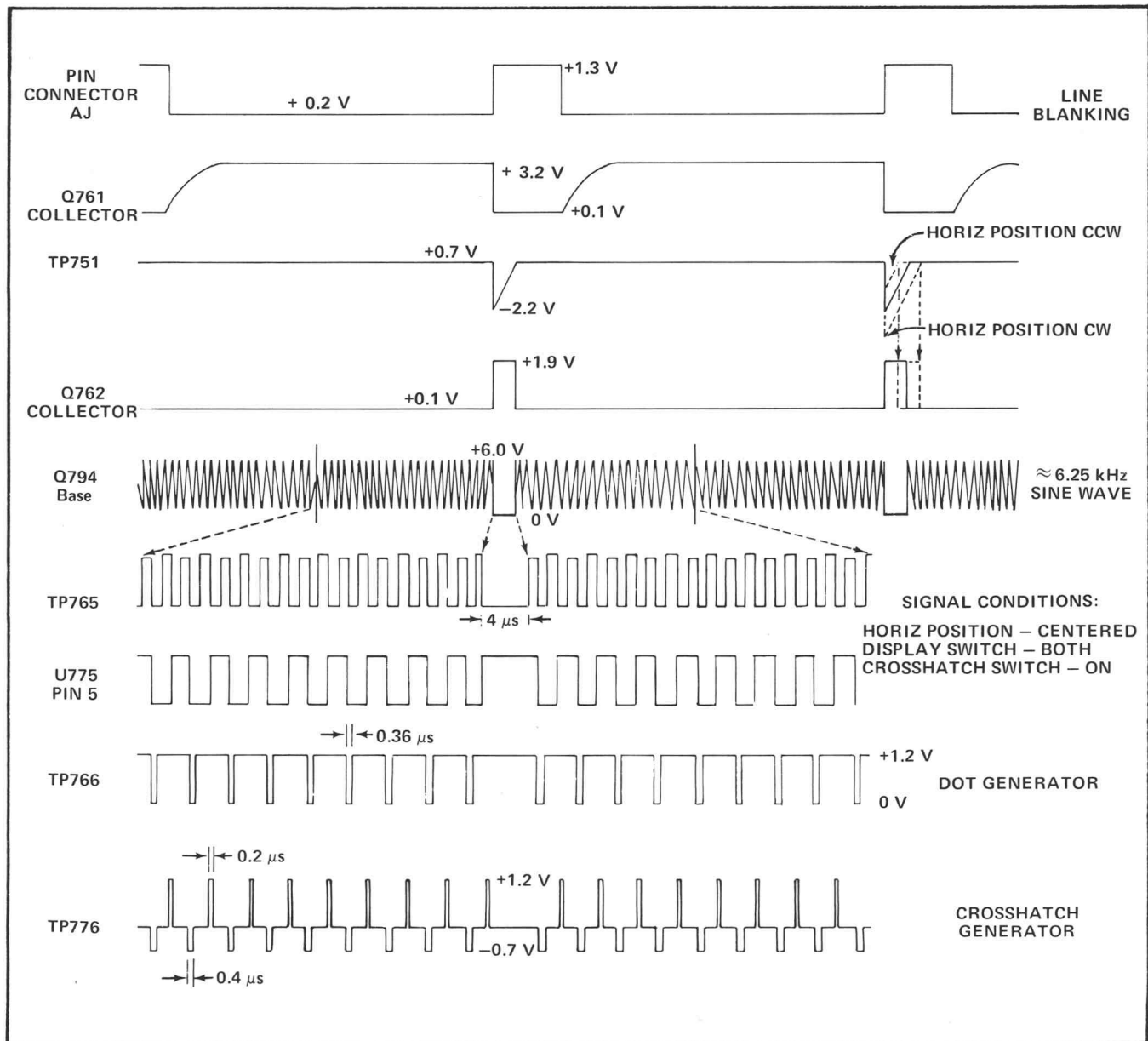


Fig. 3-17. Time-related sequential waveforms in the Vertical Generator of the Crosshatch and Dot Generator. Time scale of bottom 3 waveforms is 2 times the rate of the others.

is preset by a positive gate which is initiated by the vertical blanking signal. Width of the preset gate is determined by the setting of the VERT POSITION control.

The vertical blanking signal at pin connector Y is a positive gate to the base of Q714. The VERT POSITION circuit is very much like the HORIZ POSITION circuit previously described under Horizontal Generator Timing. A negative sawtooth appears at the base of Q715, with the sawtooth determined by the setting of the VERT POSITION control. Q715 is cut off during the sawtooth, resulting in a positive gate at the collector. R707 and C716

are a speed-up circuit which lowers the emitter impedance of Q705 for a short time when the leading edge of the sawtooth appears at the collector. This permits the collector to fall rapidly.

The positive gate from Q715 is coupled directly to pin 6 of U721 and U724 and through U725 to pin 6 of U722, U723, U731, and U734 to serve as a preset signal. The counter is locked in the preset condition for the duration of this preset gate. U722, U723, U731, and U734 are also preset each time pin 5 of U724 goes high, causing a count-down of 35:1.

U711 is a divide-by-2 counter, triggered from the trailing edge of the vertical blanking signal to allow the 35 state counter to be preset only every other field. This insures proper interlacing of the convergence pattern (see Fig. 3-18).

To shift the display one line when the VERT POSITION control is rotated, it is necessary that the preset pulse to the 32 state counter occur in the opposite field. U712B determines the field to which the preset pulse occurs. This is accomplished as follows: the preset pulse appearing at the output of Q715 is differentiated by R711 and C712. The differentiated pulse is applied to pin 3 of U712B. The gate is open only if the 15,734 Hz signal to pin 5 is negative at the same instant the negative spike appears at pin 3. If the gate opens, a preset to U711 causes this flip-flop to change states. When the flip-flop changes states, one count is added and a field change occurs. CR703 and C702 insure that the gate of U712B is open less than 50% of the time for the 15,734 Hz signal. This gives the system a hysteresis, thereby making the flip-flop favor its present state. The action of U712B can best be described as a vernier vertical position control.

To produce crosshatch a pattern display with lines and dots centered with respect to each other, to minimize flicker, and to maintain standards, 15 horizontal rows of lines and dots must be generated (35:525). U721, U722, U723, U724, U731, U734, and U741A are the stages of the 35 state counter, used for generating timing signals necessary to insure the above-listed conditions. The counter is triggered by the trailing edge of the line blanking signal at pin 2 of U731. Refer to Fig. 3-19 for the time-related waveforms of the counter.

U732, U733, U735B, U741B, U742, U743B, and U744 are the logic stages required to combine the timing signals from the 35 state counter to produce the proper interlace of the convergence signals. Line logic is obtained from U742 and U744, while U735B and U733 are the dot logic stages. Referring to Fig. 3-18 and Fig. 3-19, it can be seen that three field lines are required to produce one dot and that two field lines are needed for one line. Only after one complete frame will the complete dots and lines be formed. Dot and line interlacing logic information is also given in Fig. 3-19 by a series of dashed lines from the input signals to the output signals. U735A, U743A, and U745 comprise the field line and dot pulse combination logic circuitry. Timing gates from the various integrated circuits of the Field Timing Generator and the line and dot pulse information form the Horizontal Timing Generator circuits are combined to produce the crosshatch drive to the output.

Output Amplifier

The Output Amplifier includes Q728, Q737, Q738, Q739, Q787, Q788, Q789, Q797, Q798, and Q799. Q787,

Q788, Q789, Q797, Q798, and Q799 perform the current-switching necessary to combine the composite blanking, composite sync, and the convergence pattern information to form the complete convergence pattern signal. This convergence pattern current then drives the filter, L768 and L769.

The filter has a sine-squared response with a risetime of 115 ns, which prevents ringing in transmission cables connected to the output connectors. The filter is terminated by R759 at the emitter of Q739.

Q728, Q737, Q738, and Q739 form an operational amplifier. Characteristically, the input impedance is very low and the signal voltage at the emitter of Q739 will be only a few millivolts. R_f for the amplifier consists of R729 and R739. Adjustment of R729 sets the gain of the stage, providing a calibrated amplitude at the output.

Q737 sets the emitter voltage of Q738 and acts as temperature compensation. CR749 in the base circuit of Q739 is also temperature compensation.

The amplified convergence signal is coupled through R718 and R719 for use at the front- and rear-panel CONVERGENCE PATTERN connectors.

LOW VOLTAGE POWER SUPPLY

8

The Low Voltage Power Supply circuit provides the operating power for the Type R140 from three regulated supplies, -15 volts, +3.6 volts and +10 volts, and a +10 volt unregulated supply. Electronic regulation is used to provide stable, low ripple output voltages. All the regulated supplies are current limited to prevent instrument damage in the event that a supply is inadvertently shorted to ground. The primary circuit of the transformer employs voltage and range selector plugs to permit selection of the line voltage operating range.

Power Input

Power is applied to the primary winding of transformer T1 via RF1 Filter FL4, the POWER switch S4, 115 volt line fuse F2, Voltage Selector plug S3 and the Range Selector plug S2. The Voltage Selector plug S3 connects the split primaries of T1 in parallel for 115 volt range of operation, or in series for 230 volt range. A second line fuse, F3, is connected into the circuit when the Voltage Selector plug is placed in the 230 volt position to provide the correct protection for 230 volt operation. The current rating of F3 is approximately one half of F2.

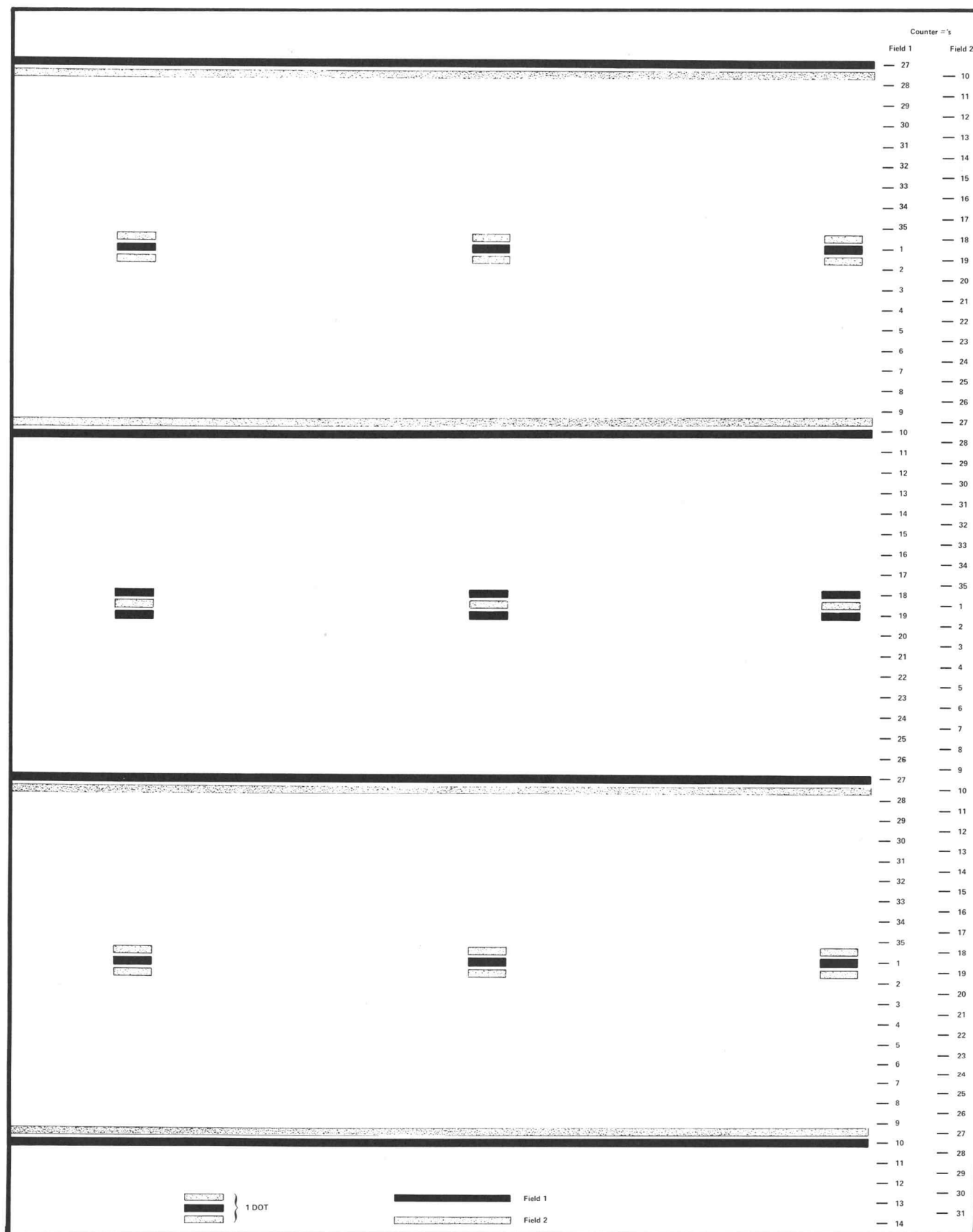
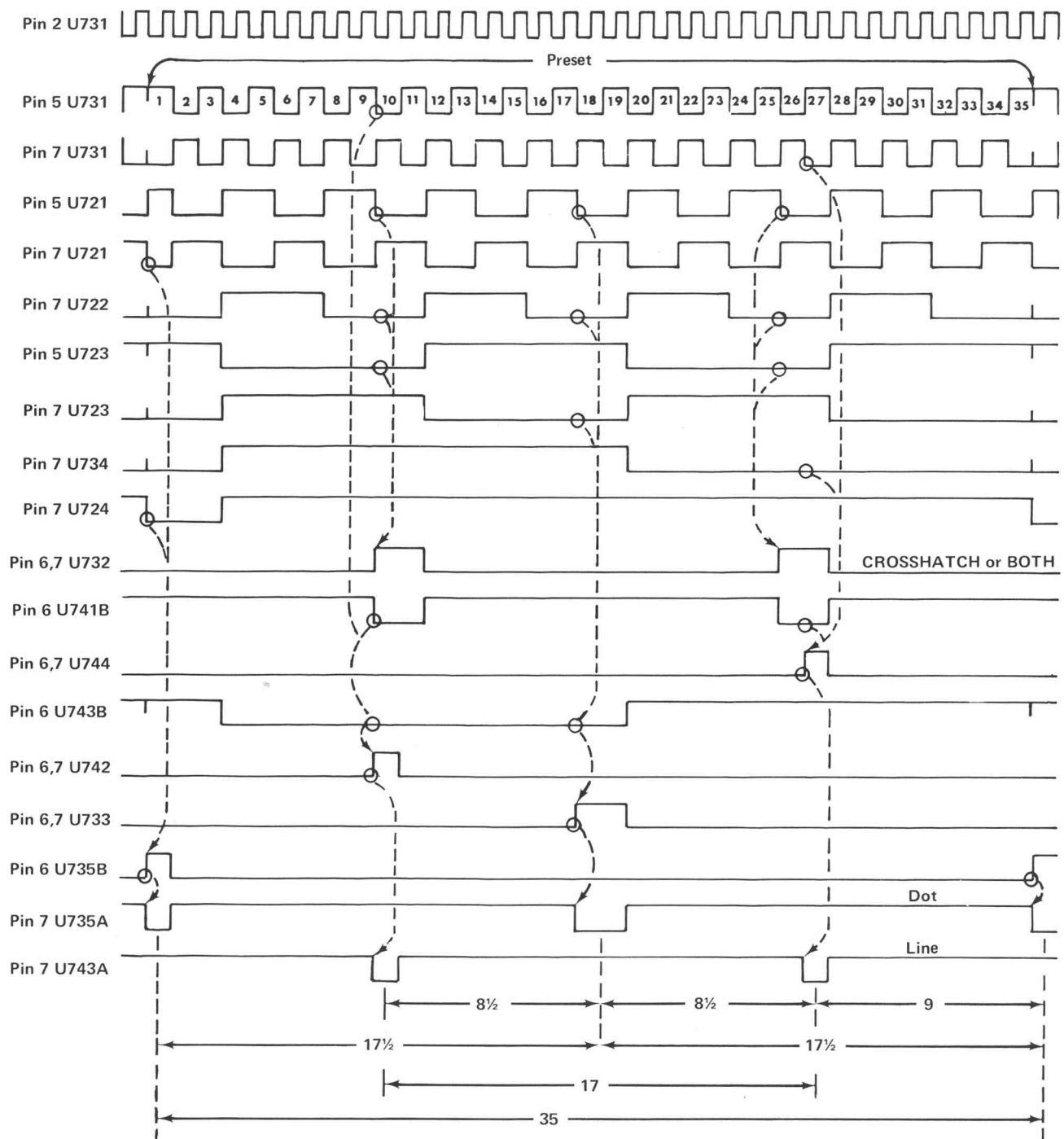


Fig. 3-18. Partial view of convergence interlacing pattern in relation to 35 state counter.



Dashed lines with arrows indicate input to output of indicated logic stage.

Fig. 3-19. Time-related sequential waveforms in the Field Timing Generator and Logic outputs.

Circuit Description—Type 140/R140

Range Selector plug S2 allows the instrument to regulate properly on higher or lower than normal line voltages. Each half of the primary has taps above and below the 115 volt (230 V) point. As the Range Selector plug is moved from LO to M and then to HI, more turns are added to the primary winding. Therefore, whether the primary voltage has increased or decreased, the secondary voltage can be maintained at a nearly constant level ($E_s = E_p \times N_s/N_p$).

The RF1 Filter FL4 serves to prevent external RF interference from appearing across T1 and also prevents signals generated within the Type R140 from being introduced onto the AC line.

—15 Volt Supply

The —15 volt supply provides the reference voltage for the +3.6 volt and +10 volt supplies (see Fig. 3-20). The reference for the —15 volt supply is a 9.1 volt zener VR870.

The output from the secondary winding (terminals X and Y) of T1 is rectified by a full-wave rectifier consisting of CR861 and CR862. The rectified voltage is filtered by C61 and applied through a —15 Volt Series Regulator stage Q85 before being supplied to the load. Series Regulator Q85 and its Driver E.F. (Emitter Follower) Q880 are controlled by a Voltage Comparator consisting of Q875 and Q876 with associated components.

The base of Q875 in the Voltage Comparator stage is referenced by a 9.1-volt temperature-compensated zener diode, VR870. The voltage on the base of Q876 is determined by a divider network consisting of R885, —15 Volts control R886 and resistor R887. Variable resistor R886 adjusts the base voltage of Q876 so the output voltage of this supply is —15 volts within a tolerance of 3%. The collector potential of Q875 is applied to Driver circuit Q880; this circuit controls Q85, connected as a series regulator.

Assume that the —15 volt supply tends to go in the positive direction (toward —14 volts). This positive-going voltage change is applied to the base of Q876, increasing the current through Q876. The increased current through Q876 decreases the conduction of Q875 and causes the voltage change at the collector of Q875 to be positive-going. This positive-going voltage change is applied to the base of Q880, causing the current through Q880 to increase. The increased current through Q880 causes a positive-going voltage change to occur at its emitter, and this change is applied to the base of Q85. Transistor Q85 increases its conduction. This increased conduction through Q85 effectively decreases its internal resistance and voltage drop, thus increasing the available voltage to the —15 volt

supply to offset the original tendency for the supply to go toward —14 volts. Filter capacitor C885 suppresses sudden load changes that fall outside the bandwidth of the regulator circuit.

Network R880 and C880 suppresses any tendency for the Voltage Comparator stage to oscillate. C871 filters out any noise generated by VR870.

Q860 with associated components is an overload protection circuit. This transistor is normally cut off. However, if the —15 volt supply load current is excessive, current through R861 forward biases Q860. The collector current from Q860 flows through R816 (in the +10 volt supply) and causes the base of Q830 to go in the negative direction. The emitter of Q830 follows the base, pulling the base of Q35 down and shutting down the +10 volt supply.

The negative-going voltage change at the emitter of Q830 also appears across R831 and is coupled through R875 and C875 to the base of Q880. The emitter of Q880 follows this change, pulling down the base of Q85 which shuts down the —15 volt supply.

Notice, from this description, that an overload on the —15 volt supply causes both the +10 volt and —15 volt supplies to shut down.

+3.6 Volt Supply

Full wave rectification for the +3.6 volt supply is provided by CR841 and CR842. The rectified voltage is filtered by C42 and applied to the +3.6 Volt Series Regulator stage Q55 before being applied to the load.

The error sensing divider resistors for the +3.6 volt supply are R855, +3.6 VOLTS control R856, and resistor R857. The —15 volt supply is used as the reference for the divider. Thus, if both the —15 volt and +3.6 volt supplies are operating properly, there should be a constant 18.6 volt difference between these two supplies.

Q845 and Q846 form a comparator circuit with the base of Q845 referenced at ground. When the +3.6 volt and —15 volt supplies are at the proper voltages, the base of Q846 is also at 0 volts. If either supply voltage changes, the comparator (Q845 and Q846) is unbalanced, resulting in an error signal at the base of Q850.

Since Q850 is an emitter follower, the polarity of the error signal is the same at the emitter of Q850 and the base

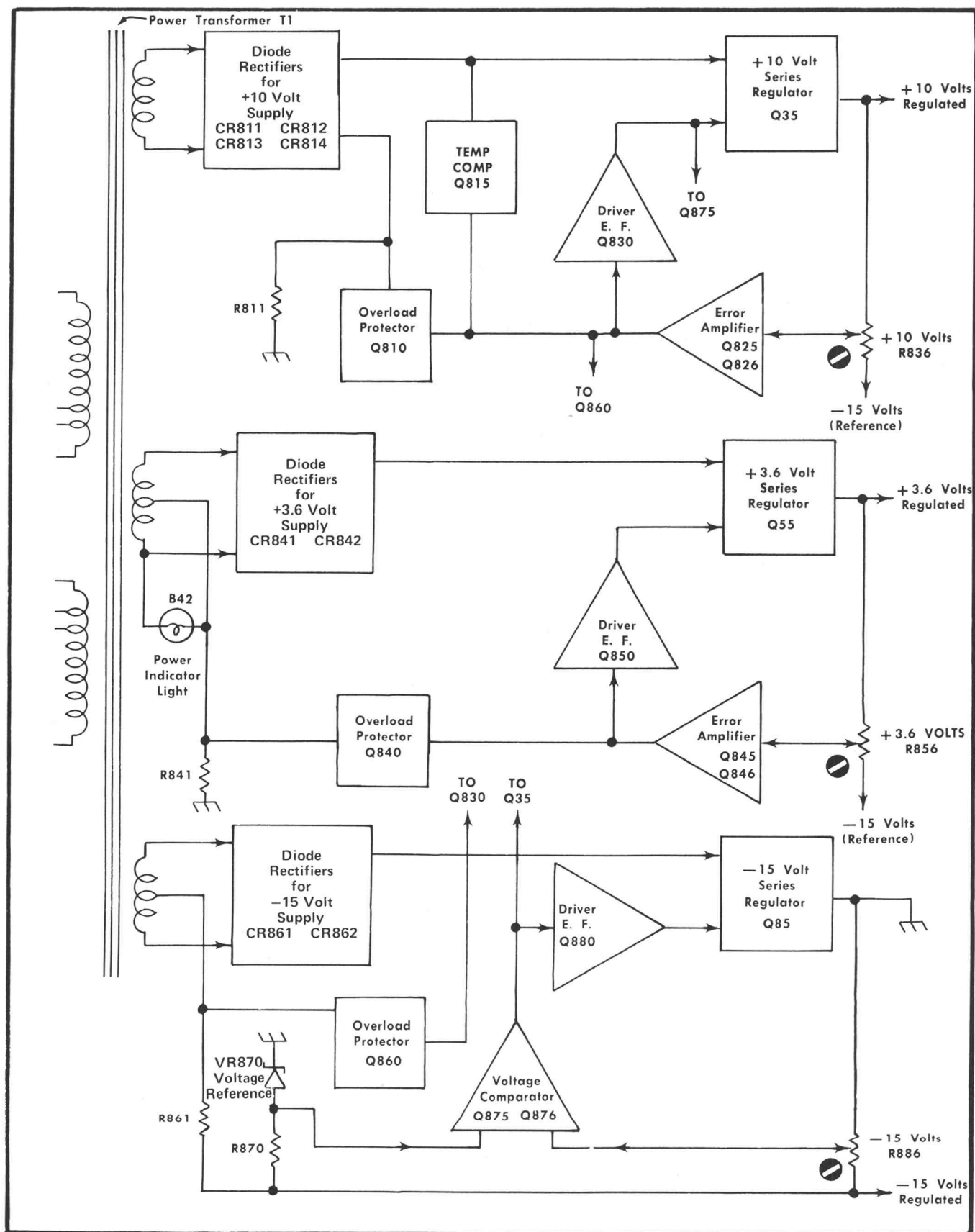


Fig. 3-20. Block diagram of the low-voltage regulated power supplies.

Circuit Description—Type 140/R140

of Q55. The error signal, applied to the base of Q55, is used to control the emitter-to-collector drop across Q55. In this way the output voltage is maintained at its rated value.

For example, if the +3.6 volt supply attempts to rise, the difference voltage across the error sensing divider resistors tends to increase and a fraction of this increase is applied as a positive-going error signal to the base of Q846. At the collector of Q846, the error signal is negative-going and this signal is applied to the base of Q850. The signal is also negative-going at the emitter of Q850, and this signal is applied to the base of Q55. The negative-going signal decreases the current through Q55 and thus increases the voltage drop across Q55 to offset the original tendency for the output voltage to increase.

Variable resistor R856 is the +3.6 VOLTS control to set the output of the supply at +3.6 volts within a tolerance of 3%. Q845 provides temperature compensation for Q846 and clamps the emitter of Q846 at about -0.6 volt. Q840 provides overload protection for the +3.6 volt supply. Q840 is normally in cutoff. If the load current for the supply becomes excessive, Q840 becomes forward biased and a negative-going signal occurs at its collector. This negative-going signal increases the internal resistance of Q55 to limit the current available at the output of the +3.6 volt supply.

Network R850 and C850 prevents the +3.6 volt regulator circuit from oscillating. Operating voltage for the POWER light DS42 is obtained from the connections across

one half of T1 secondary winding at pins C and E on the Power Supply circuit board.

+10 Volt Supply

The +10 Volt Supply is similar to the +3.6 Volt Supply. Rectified voltage for the +10 volt supply is provided by the full-wave bridge rectifier consisting of CR811, CR812, CR813 and CR814. The rectified voltage is filtered by C11 and applied to Series Regulator Q35.

The error sensing divider resistors are R835, +10 VOLTS control R836 and resistor R837. The Error Amplifier stage consists of Q825 and Q826 connected as a comparator. The base of Q825 is at ground, and, with the +10 volt and the -15 volt supplies at the proper voltages, the base of Q826 will be at 0 volts.

Any change in the +10 volt output will appear at the base of Q826 and will thus be coupled to the base of Q830 as an error signal. This error signal will be coupled to the base of Q835, opposing any tendency for the supply voltage to change.

Q815 serves as a constant current source for Q826. Q810 provides overload protection for the +10 volt supply. If the +10 volt supply load current is excessive, current through R811 forward biases Q810, which shuts down the +10 volt and the -15 volt supplies in the same manner as described for Q860 in the -15 volt supply.

SECTION 4

MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual contains information for use in preventive maintenance, troubleshooting and corrective maintenance of the Type R140.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection and lubrication. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of this instrument. The severity of the environment to which the Type R140 is subjected determines the frequency of maintenance.

Cleaning

General. The Type R140 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket that prevents efficient heat dissipation. It also provides an electrical conduction path.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents.

Exterior. Loose dirt accumulated on the outside of the Type R140 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a solution of water and mild detergent. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-

velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Lubrication

The reliability of switches and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (e.g., Tektronix Part No. 006-0172-00) for the switch contacts. This lubricant does not affect the electrical characteristics of the switch. To lubricate the switch detent, use a heavier lubricant (e.g., Tektronix Part No. 006-0219-00). Do not over-lubricate.

Visual Inspection

The Type R140 should be inspected occasionally for such defects as broken connections, loose or disconnected pin connectors, improperly seated solid-state devices, damaged circuit boards and heat-damaged components.

The corrective procedure for most defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Transistor and Integrated Circuit Checks

Periodic checks of the transistors and integrated circuits (ICs) used in the Type R140 are not recommended. The best indication of performance is the actual operation of the component in the circuit. Performance of the circuit is thoroughly checked during recalibration; substandard transistors and integrated circuits will usually be detected at that time.

Recalibration

To insure correct and accurate instrument operation, the instrument calibration should be checked each 1000 hours of operation or at least every 6 months. Performance Check and Calibration procedures are given in Section 5.

The calibration procedure can be helpful in isolating major troubles in the instrument. In some case, minor troubles not apparent during normal operation may be revealed and corrected during calibration.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in this instrument are described here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical replacement parts for the Type R140 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements or are manufactured specifically for Tektronix, Inc. These special parts are indicated in the Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, include the following information:

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Circuit boards. Use ordinary 60/40 solder and a 15 to 30 watt pencil type soldering iron on the circuit boards. A higher wattage soldering iron may separate the etched wiring from the base material.

The tip should be made of copper and have a chisel or beveled shape, with a 1/8-inch width. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint.

The following technique should be used to replace a component on a circuit board:

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board.
2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick into the hole to clean it out. A vacuum-type de-soldering tool can also be used for this purpose. If the removal is not accomplished in the first few seconds of heat application, go to another connection or wait a few minutes before reheating the connection. This is to avoid transferring too much heat to the circuit board base material.
3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.
4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint; do not apply too much solder. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers (see Fig. 4-1) or other heat sink.
5. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

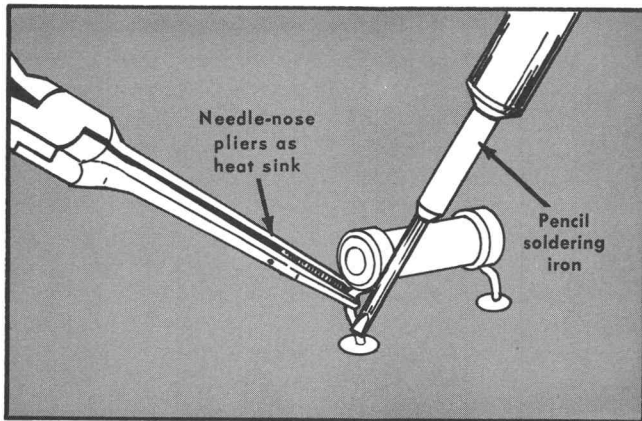


Fig. 4-1. Use of a heat sink to protect components during soldering.

Metal Terminals. When soldering to metal terminals (e.g., switch terminals, potentiometers, etc.) ordinary 60/40 solder can be used. Use a soldering iron with a 40- to 75-watt rating and 3/16-inch wide wedge-shaped tip.

Observe the following precautions when soldering to metal terminals:

1. Apply only enough heat to make the solder flow freely.
2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.
3. If a wire extends beyond the solder joint, clip off the excess.
4. Clean the flux from the solder joint with a flux-remover solvent.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Interconnecting Wires. All interconnecting wires on the Type R140 circuit boards use pin connectors. Most of these pin connectors are held in place with special type holders; see Fig. 4-2A. Should removal of an interconnecting wire(s) become necessary, the following procedure outlines the removal and replacement.

CAUTION

Do not attempt to remove a single interconnecting wire from the holder until the complete assembly has been removed from the circuit board.

REMOVAL:

1. Grasp the connector at each end and pull straight away from the circuit board.
2. Using a small screwdriver, apply a small amount of pressure between the back of the metal pin connector and the holder. This will allow the pin connector to unsnap from the holder. (See Fig. 4-2B.)

3. Grasp the top of the pin connector and remove from the holder.

REPLACEMENT:

NOTE

Before replacing wires, check the wire color codes for the particular circuit boards. These are given in Fig. 4-7 through Fig. 4-17.

1. Insert the pin connector (wide side towards the back as shown in Fig. 4-2C) into the holder.
2. Apply pressure to the upper portion of the pin connector until it snaps into the holder.
3. Align the small triangle on the holder body with the triangle on the circuit board (see Fig. 4-2D) and mate the pin connectors.
4. Press the holder firmly down against the circuit board.

Circuit Boards. If the circuit board is damaged beyond repair, replacement can be made of the entire assembly including all soldered-on components, or of the board alone. Part numbers are given in the Mechanical Parts List for either the completely wired or the unwired board. The following procedure outlines the removal and replacement of the boards.

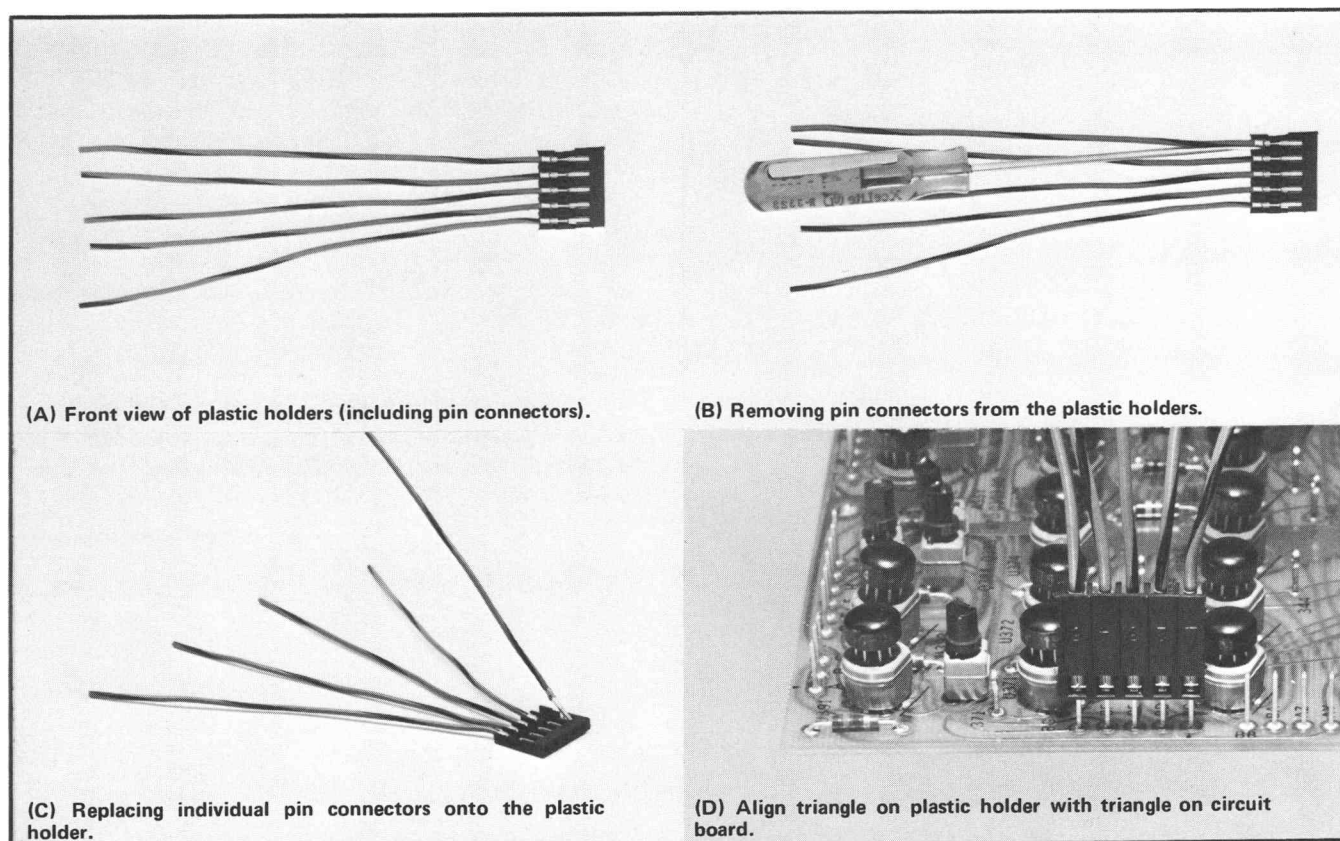


Fig. 4-2. Removal and replacement of interconnecting wires and plastic holders.

REMOVAL:

1. Remove all interconnecting wires from the circuit boards.
2. Remove board hold-down screws (Output Amplifier, Power Supply, Convergence Pattern, and Subcarrier Output only) and/or unsnap one edge of the board from the plastic mounting clips.
3. Remove the circuit board.

REPLACEMENT:

1. Replace the hold-down screws and/or insert one edge of the circuit board so that the board notches fit into the plastic mounting clips.
2. Snap the circuit board into place.
3. Reconnect all interconnecting wires to the circuit board.

Transistor and Integrated Circuit Replacement. Transistors and integrated circuits, (ICs) should not be replaced unless they are actually defective. Replacement or exchange of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as on the component being replaced. Use Fig. 4-3 as a reference for insertion.

The chassis-mounted power supply transistors and their mounting bolts are insulated from the chassis. In addition, silicone grease is used to increase heat transfer capabilities. Re-install the insulators and replace the silicone grease when replacing these transistors. The grease should be applied to both sides of the mica insulators, and should be applied to the bottom side of the transistor where it comes in contact with the insulator.

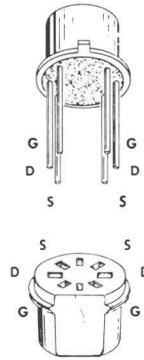
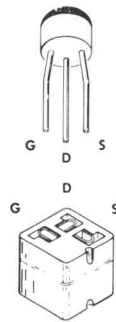
WARNING

1. *Silicone grease should be handled with care and should be kept away from the eyes. Wash hands thoroughly after contact with the grease.*

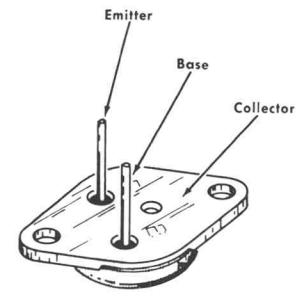
INTEGRATED CIRCUITS



FIELD EFFECT TRANSISTORS

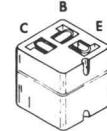
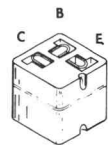
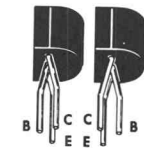
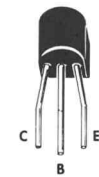


POWER TRANSISTORS



OTHER TRANSISTORS

Epoxy Cased



Metal Cased

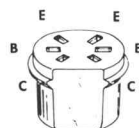
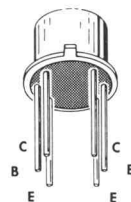


Fig. 4-3. Electrode configuration for socket mounted Integrated Circuits and Transistors.

2. *Voltages are present on the exterior surface of the chassis-mounted power supply transistors if the power is applied to the instrument and the POWER switch is on.*

After any component is replaced, check the operation and calibration of the associated circuits.

Indicator Lamp Replacement. The oven lamp can be removed from the front panel. To remove the lamp, unscrew the lens; use fingernails to grip the lamp, and pull outward. To replace the lamp, insert it and rotate it while applying light pressure. After the pins align with the socket, push the lamp fully into place. Replace the lens.

To remove the Power On indicator lamp, first remove the top cover from the instrument. Then, reach behind the front panel and unplug the lamp from its holder. To replace the lamp, reverse the procedure.

Fuse Replacement. Both line fuses are contained in plastic holders in the cover for the Line Voltage Selector Assembly at the rear of the instrument. To remove the fuses, disconnect the line cord from the power source and remove the cover of the assembly. Push on the end of the fuse to be removed and slide it out of the holder. Replace the fuse in a similar manner, being sure the cover fits snugly against the rear panel of the instrument.

Use only the correct value replacement fuse. A smaller value will tend to blow out; a larger value will not provide adequate protection for the instrument. Only the upper fuse within the assembly (3/4 A) is used for 115-volt operation. However, for 230-volt operation both the upper and lower fuse (1/2 A) must be installed.

Switches. If a switch is defective, replace the entire assembly. Replacement switches can be ordered by referring to the Parts List for the applicable part numbers.

When replacing a switch, tag the leads and switch terminals with corresponding identification tags as the leads are disconnected. Then, use the old switch as a guide for installing the new one. An alternative method is to draw a sketch of the switch layout and record the wire color at each terminal. When soldering to a new wafer type switch, be careful that the solder does not flow beyond the rivets on the switch terminals. Spring tension of the switch contact can be destroyed by excessive solder.

Power Transformer Replacement. The power transformer in this instrument is warranted for the life of the

instrument. If the power transformer becomes defective, contact your local Tektronix Field Office or representative for a warranty replacement (see the Warranty note in the front of the manual). Be sure to replace only with a direct replacement Tektronix transformer.

When removing the transformer, tag the leads with the corresponding terminal numbers to aid in connecting the new transformer. After the transformer is replaced, check the performance of the complete instrument using the Performance Check procedure.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the Type R140. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles. See the Circuit Description section for complete information.

Troubleshooting Aids

Diagrams. Circuit diagrams are provided on foldout pages in Section 8. The component number and electrical value of each component in this instrument are shown in the diagram. Each main circuit is assigned a diagram number. Table 4-1 lists the main circuits in the Type R140 and their assigned diagram numbers. Important voltages and waveforms are also shown on the diagrams. The portions of the circuit mounted on circuit boards are enclosed with a blue-line. Also included are the circuit board interconnecting wire and switching diagrams.

TABLE 4-1

Diagram	Circuit
1	Modulator
2	Bar Timing
3	Field Timing
4(a)	Color Bar Drive
4(b)	Video Out
5	Staircase
6(a)	Line Timing
6(b)	Subcarrier & Sync Source Switching
7	Crosshatch & Dot Generator
8	Power Supply
9	Output Amplifiers
10 & 11	Subcarrier Oscillator & Output

Switch Wafer Identification. The VITS Line selector switch shown on the Field Timing diagram is coded to indicate the position of the wafer in the complete switch assembly. The numbered portion of the code refers to the wafer number counting from the front, or mounting end of the switch, toward the rear. The letters 'F' and 'R' indicate whether the front or rear of the wafer performs the particular switching function. For example, a wafer designated 3R on the diagram indicates that the rear of the third wafer is used for this particular switching function.

Circuit Boards. Fig. 4-6 shows the location of each circuit board within the instrument. Figs. 4-7 through 4-17 show a full view of each circuit board. Each electrical component on the boards is identified by its circuit number, and all wire color codes are shown. These pictures, used along with the diagrams, aid in locating the components on the circuit boards.

Wire Color Code. All insulated wires in the Type R140 are color coded to facilitate circuit tracing. Table 4-2 summarizes the coding system used by Tektronix, Inc. for chassis wiring in all its instruments at this time.

TABLE 4-2

Color Code	Significance
Black	Chassis ground
White on Black	Floating ground
Yellow on Green	Safety ground
Brown ¹	Filament and heaters
Gray ¹	AC line
White ¹	Signal
Red ²	B+
Violet ²	B—

¹ Color stripes are used on these wires as an aid to circuit tracing.

² Color stripe on wire indicates position of supply with respect to 0 volts (e.g., a brown stripe on a red wire would be the second voltage in the positive direction). If a second stripe is used (white only), this indicates a non-regulated supply.

Table 4-3 is provided to list the wire color code for the regulated non-decoupled DC power supply voltages used in the Type R140.

TABLE 4-3

Type R140 Power Supply Wire Color Code

Supply	Color Code
—15 V	Black on Violet
+3.6 V	Black on Red
+10 V	Brown on Red

Resistor Color Code. In addition to the brown composition resistors, metal film resistors (identifiable by their gray or light blue color) are used in the Type R140. The resistance value of composition and metal film resistors is color-coded on the components with the standard EIA color code. The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes consisting of two significant figures, a multiplier and a tolerance value. Metal-film resistors have five stripes which consist of three significant figures, a multiplier and a tolerance value. Metal-film resistors have five stripes which consist of three significant figures, a multiplier and a tolerance value (see Fig. 4-4).

Capacitor Markings. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type R140 are color-coded in picofarads using a modified EIA code (see Fig. 4-4).

Diode Color Code. The cathode end of each glass-enclosed diode is indicated by a stripe, a series of stripes, or a dot. For metal-enclosed diodes, the anode and cathode are marked on the case. When the diode is a JEDEC registered device, a series of stripes indicates the diode type number using the EIA color-code system. On diodes manufactured especially for Tektronix, a four-band color code system is used, the first band of which is either blue or pink. On the latter type of diodes, the last three bands identify the diode within a class of part numbers (e.g., a diode color-coded blue (or pink) brown-gray-green probably indicates Tektronix Part Number 152-0185-00). When in doubt, consult the Parts List.

Transistor and IC Lead Configuration. Fig. 4-3 shows the lead configuration for socket mounted transistors, FETs and ICs used in the Type R140.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the Type R140:

1. Transistor Tester

Description: Tektronix Type 576 Transistor-Curve Tracer or equivalent.

Purpose: To test the semiconductors used in this instrument.

2. Multimeter

Description: VOM, 20,000 ohms/volt DC. 0 to 30-volt range DC, 0 to 150-volt range AC; accuracy within 0.3% to measure power supply output voltages, within 3% for other circuit voltage readings; ohmmeter 0 to 50 megohms. Test prods must be insulated to prevent accidental shorts.

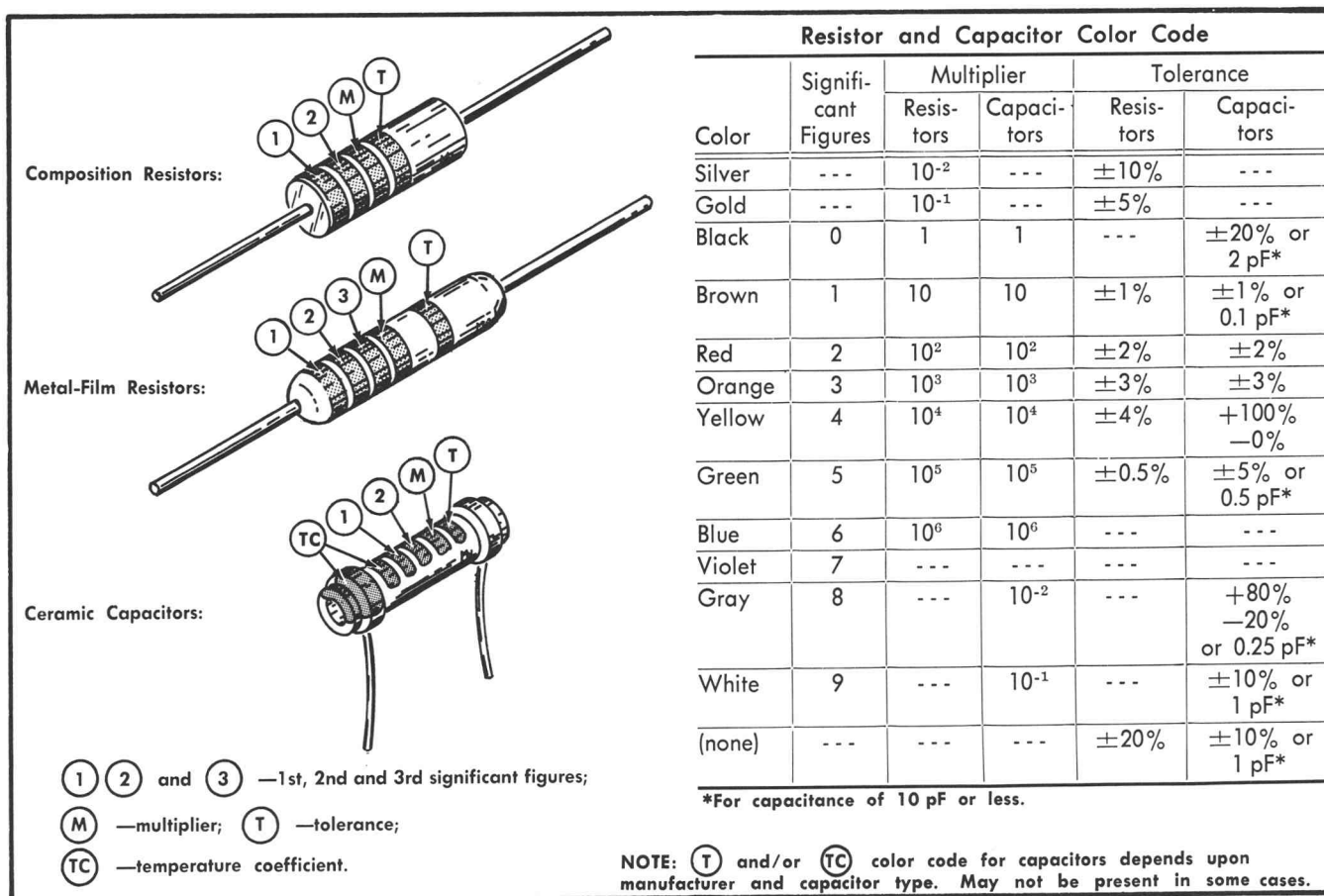


Fig. 4-4. Standard EIA color coding for resistors and capacitors.

NOTE

This instrument may be checked with a VTVM having a 10 megohm input impedance and a 0 to 30-volt range DC, 0 to 150-volt range AC. To measure power supply voltages, the meter needs accuracy within 0.3%. Accuracy within 3% is adequate for other circuit voltage readings. The ohmmeter needs a range of 0 to 50 megohms.

Purpose: To check voltages and for general troubleshooting in this instrument..

3. Test Oscilloscope

Description: DC to 10 MHz frequency response (signal tracing). 10 millivolts to 10 volts/division deflection factor using a 10X probe.

Purpose: To check waveforms in this instrument.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple possibilities before proceeding

with extensive troubleshooting. The first few checks assure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedure given under Corrective Maintenance.

1. Check Control Settings. Incorrect control settings can indicate trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions.

2. Check Associated Equipment. Before proceeding with troubleshooting of the Type R140, check that the equipment used with the instrument is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source.

3. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications, such as unsoldered connections, loose pin connectors, broken wires, damaged circuit boards, damaged components, etc.

4. Check Instrument Calibration. Check the calibration of this instrument, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Performance Check/Calibration section.

5. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptoms. The symptoms often identify the circuit in which the trouble is located. For example, if one luminance step in the composite video staircase signal is absent, this indicates that the Staircase Luminance Amplifier circuit is probably at fault. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. A defective component elsewhere in the circuit can also appear as a power-supply trouble, and affect the operation of other circuits. Table 4-4 lists the tolerance of the power supplies in this instrument when measured at the test points given in the table. Fig. 4-5 shows the locations of these test points. If a power supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Calibration section to adjust the power supplies.

Table 4-4 also lists the approximate power supply resistances when measured between each of the power supply test points and ground. Two resistance measurements are given: (1) With the + (positive polarity) lead of the VOM connected to the power supply test point, and (2) with the – (negative polarity) lead connected to the same power supply test point. Since these measurements are not absolute and may vary considerably between instruments and because of the type of ohmmeter used, space is provided in the table for filling in the information that pertains to a particular instrument and ohmmeter.

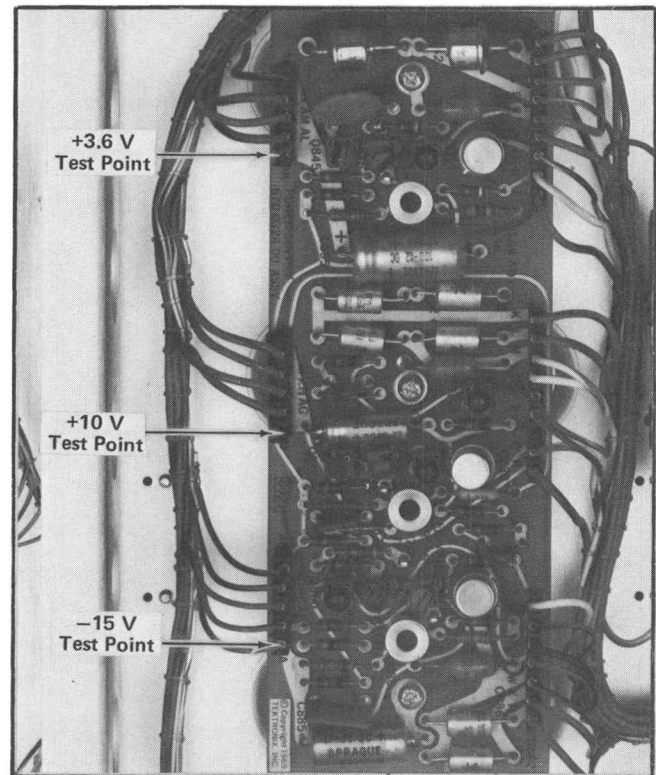


Fig. 4-5. Power Supply board test point locations.

Figs. 3-1 through 3-3 in the Circuit Description section can be used as a guide for isolating a trouble. These illustrations are functional block diagrams that show how the various signal components are combined to form the composite video signal. By using the front-panel controls and checking the signals at the BNC connectors, it is possible to determine the blocks or circuits that are functioning properly and those that are not.

When a trouble is isolated to the smallest possible area, proceed with steps 6 through 8 in this troubleshooting procedure to locate the defective component(s).

TABLE 4-4
Power Supply Voltages and Approximate Resistances

Power Supply	Test Point	Tolerance	Type of Meter: Triplett			Type of Meter:		
			Model: 630-NA			Model:		
			Instrument Type: R140			Instrument Type:		
			Serial No.:			Serial No.:		
			Resistance Measurement		Ohms Range Used	Resistance Measurement		Ohms Range Used
			+Lead	–Lead		+Lead	–Lead	
–15 V	AA	±3%	270Ω	210Ω	X100			
+3.6 V	AK	±3%	120Ω	190Ω	X100			
+10 V	AF	±3%	230Ω	240Ω	X100			

6. Check Circuit Board Interconnections. After the trouble has been isolated to a particular area or circuit, check the pin connectors on the circuit board for correct connection. Figs. 4-7 through 4-17 show the correct connections for each board.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated to the power supply itself by disconnecting the power distribution pin connectors for the voltage at the Power supply board when making resistance to ground checks.

7. Check Voltage and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the inside portion of the Modulator diagram pull-out pages.

CAUTION

Due to the component density on the circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients which may destroy many components.

WARNING

"Ground lugs" are not always at ground potential. Check the schematic before using such connections as a ground for the voltmeter test prod or oscilloscope probe. Some transistor cases may be elevated.

8. Check Individual Components. The following procedures describe methods of checking individual components in the Type R140. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

A. TRANSISTORS (excluding FETs). The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new transistor or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as Tektronix Type 576). Static-type testers are not recommended since they do not check operation under simulated operating conditions.

B. FET and IC Replacement. FETs and ICs should not be replaced unless they are actually defective. The best method for checking these devices is by direct substitution. Be sure the voltage conditions of the circuit are not such that the replacement component might also be damaged.

C. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 millivolts and 3 volts, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High current may damage the diodes.

D. RESISTORS. Check the resistors with an ohmmeter. Check the Electrical Parts List for the tolerances of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

E. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

F. CAPACITORS. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open coupling capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes the AC signals.

G. Power Input Connector and RFI Filter. This item is replaceable as a unit and repair should not be attempted. If it is necessary to replace this unit, be sure to observe polarity to assure protection for the instrument. The narrow blade (terminal 4) should show continuity to terminal 3 which connects to fuse F2. The filter contains an internal non-replaceable fuse between terminals 4 and 3. Use care when soldering to terminals 1 and 3, as excess solder could cause a short to the filter case.

9. Repair and Readjust the Circuit. If any defective parts are located, follow the replacement procedure given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

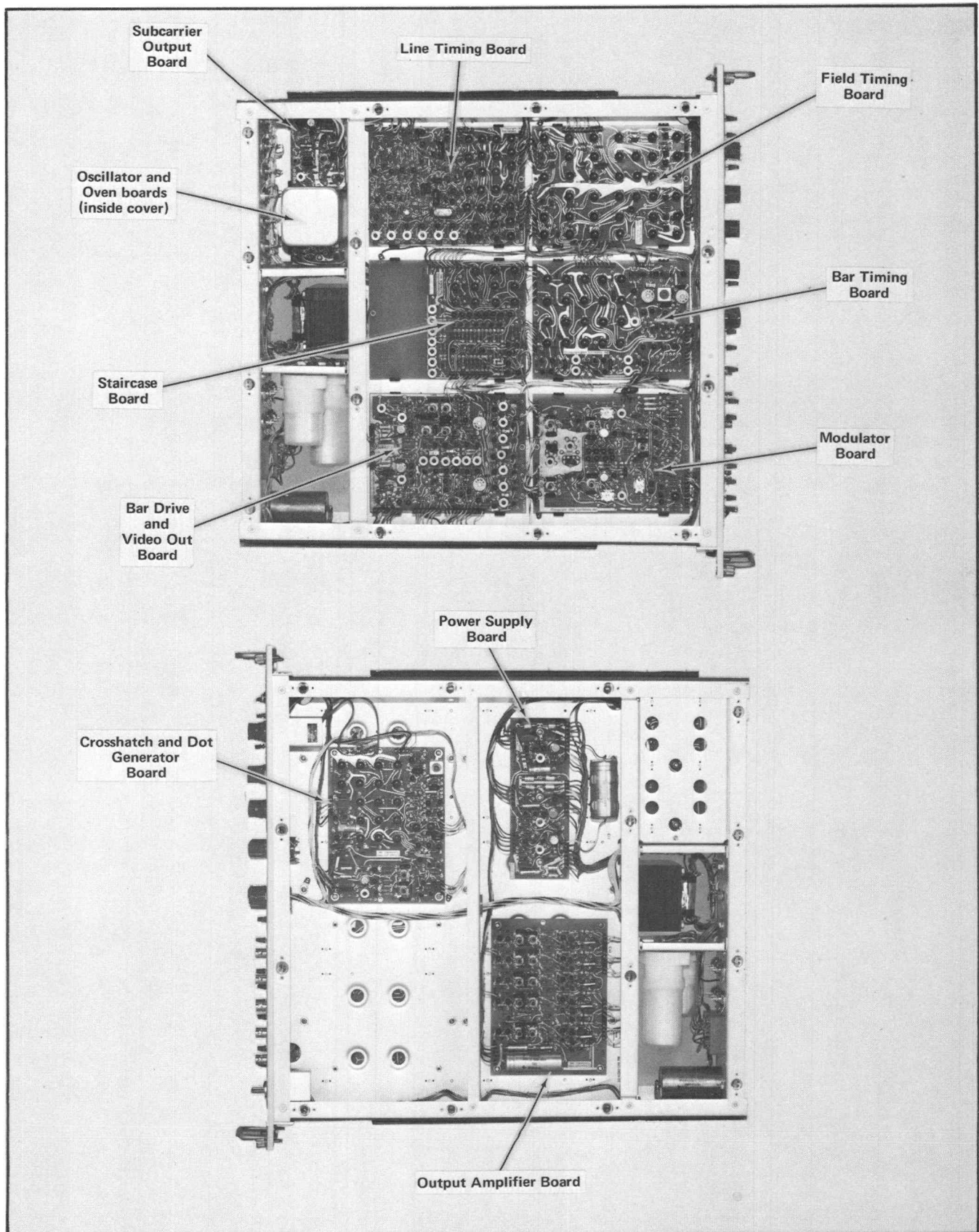


Fig. 4-6. Location of circuit boards in the Type R140.

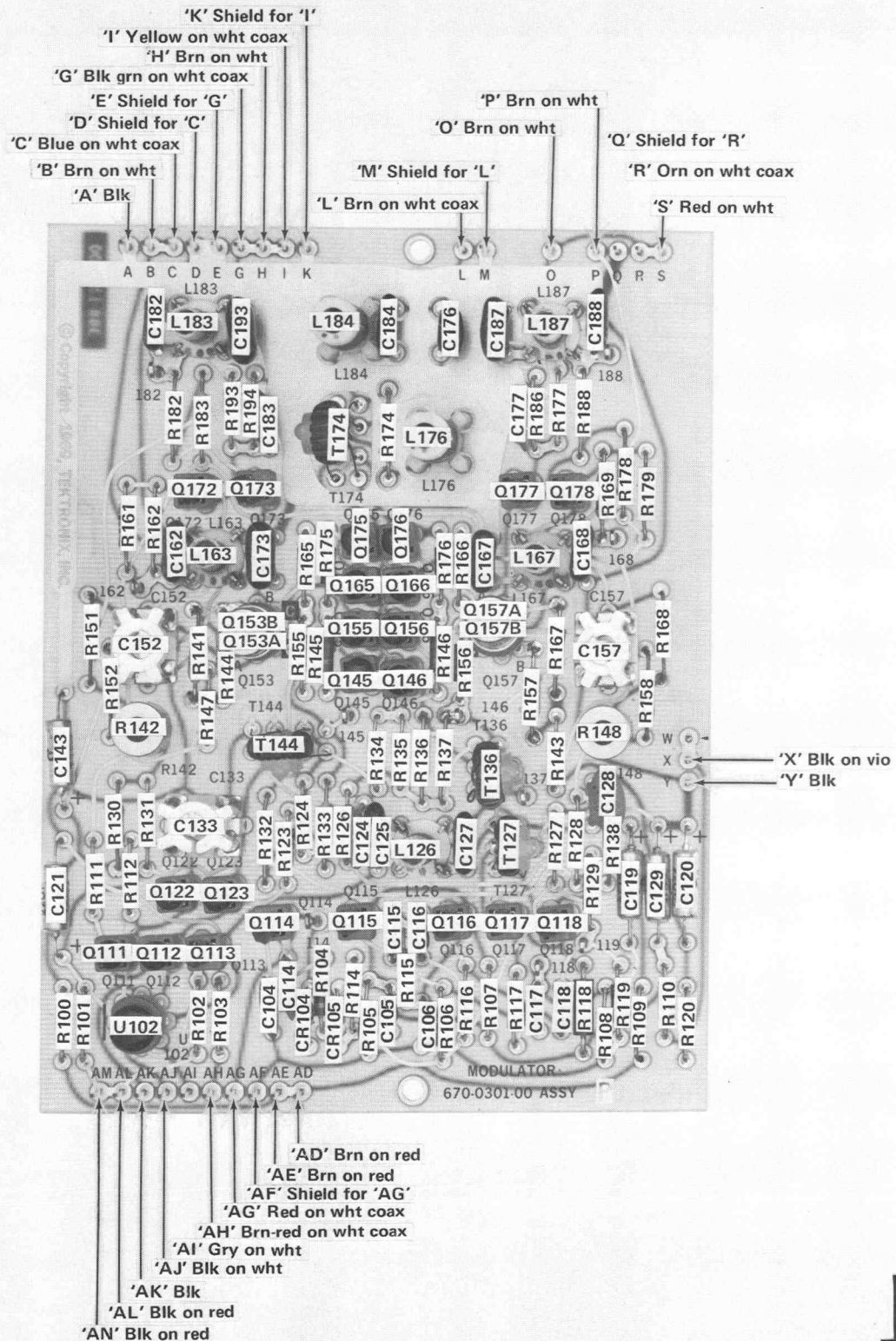


Fig. 4-7. Modulator board; component identification and wire color code.



4-13

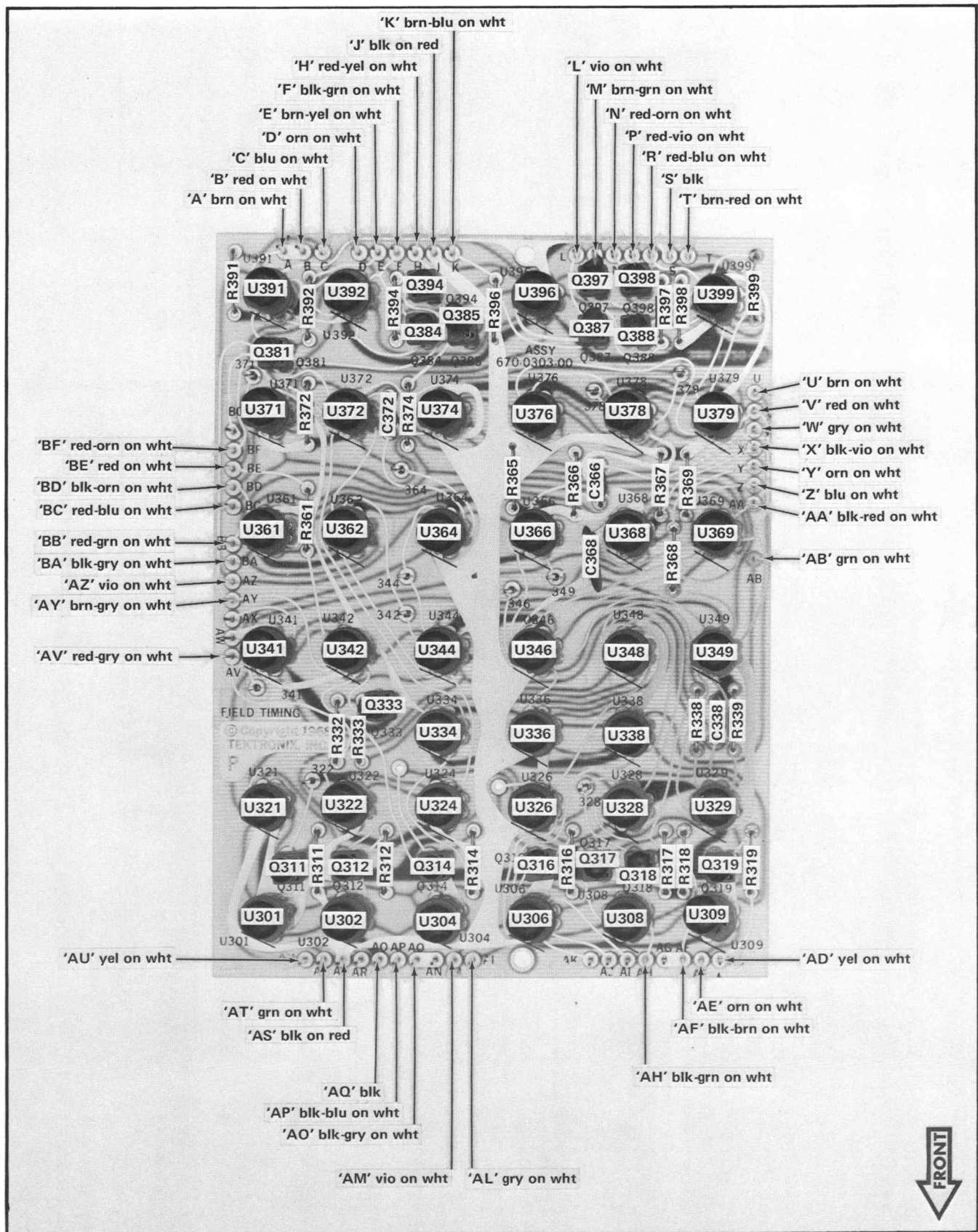


Fig. 4-9. Field Timing board; component identification and wire color code.

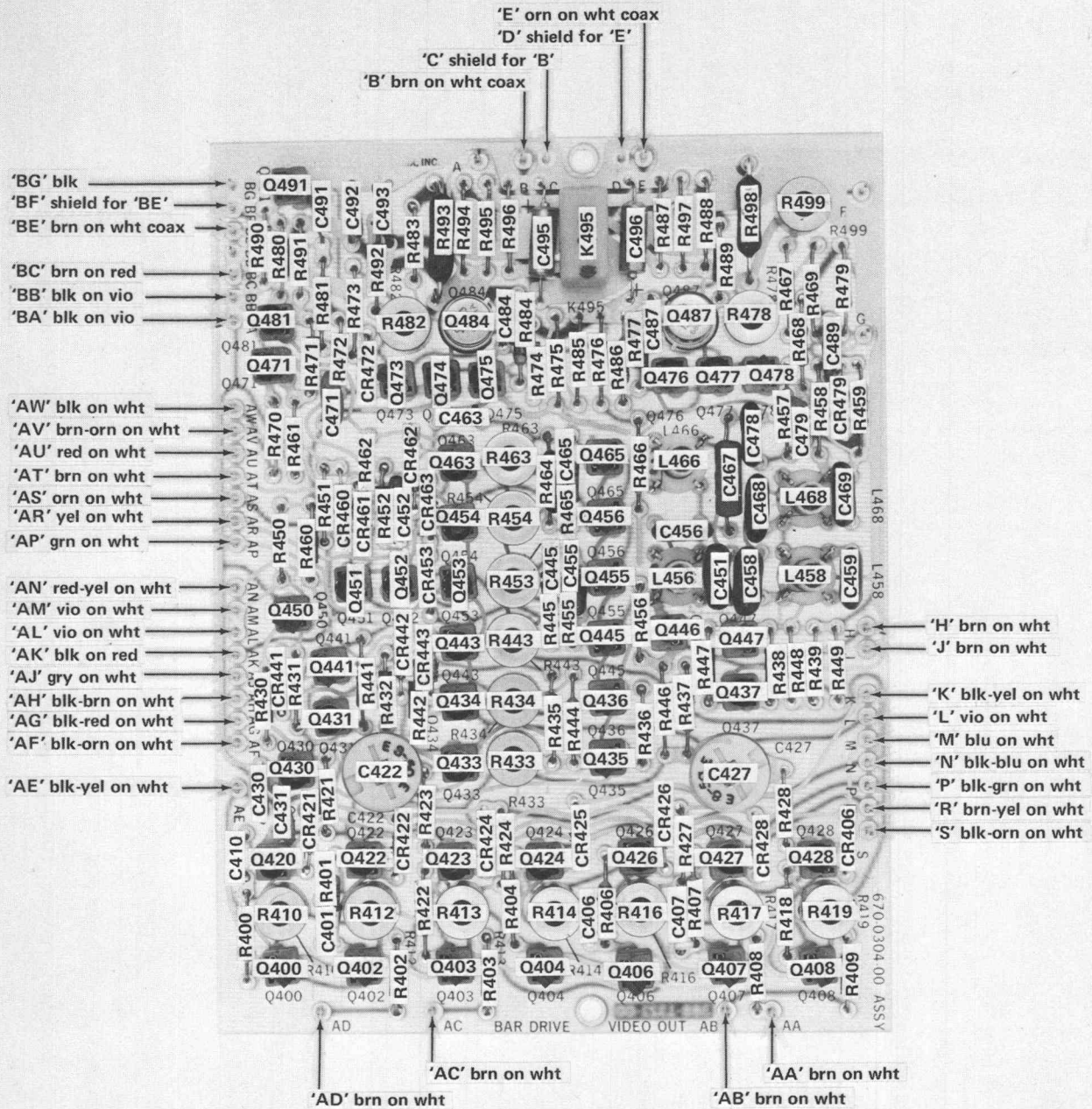


Fig. 4-10. Color Bar and Video Out board; component identification and wire color code.

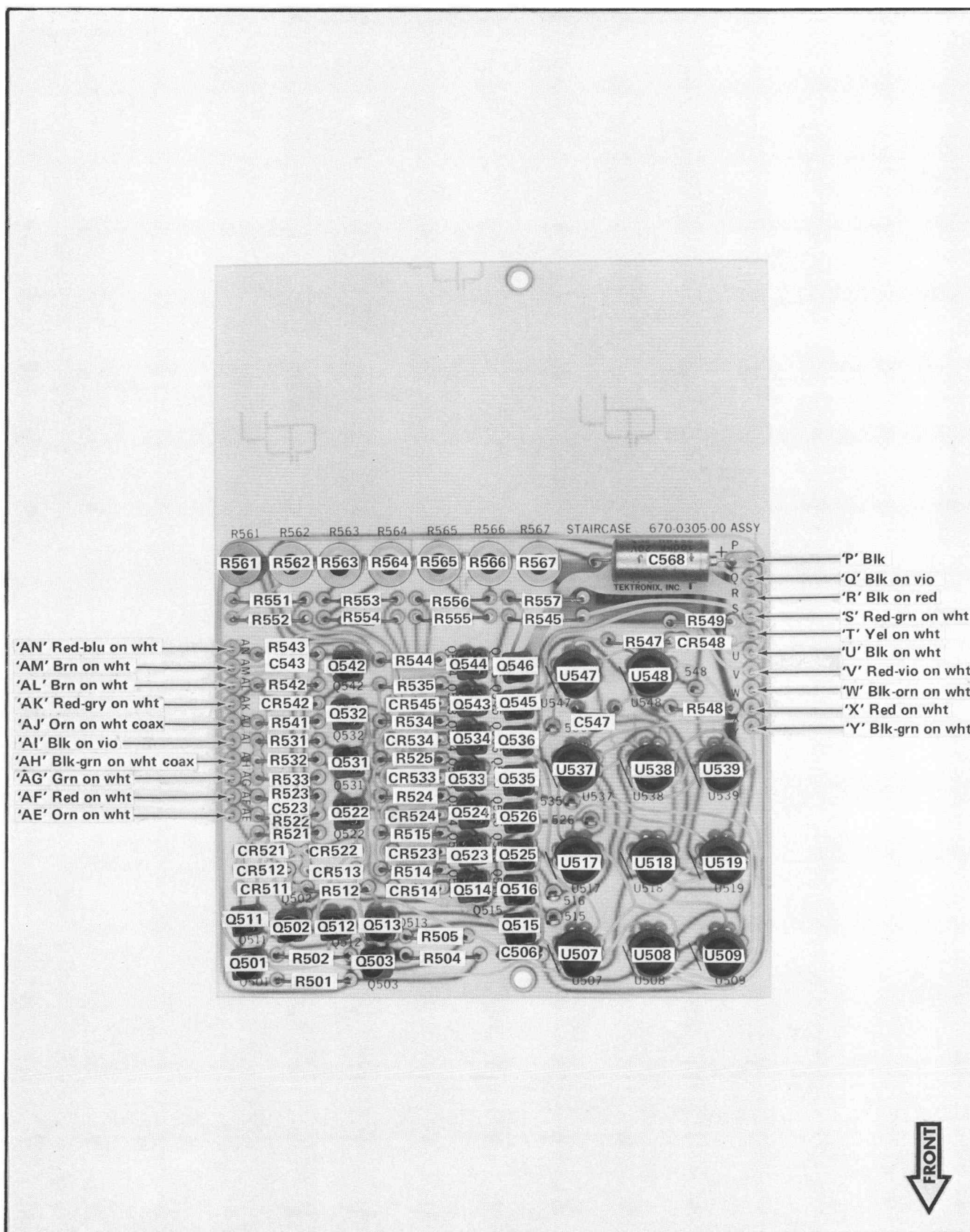


Fig. 4-11. Staircase board; component identification and wire color code.

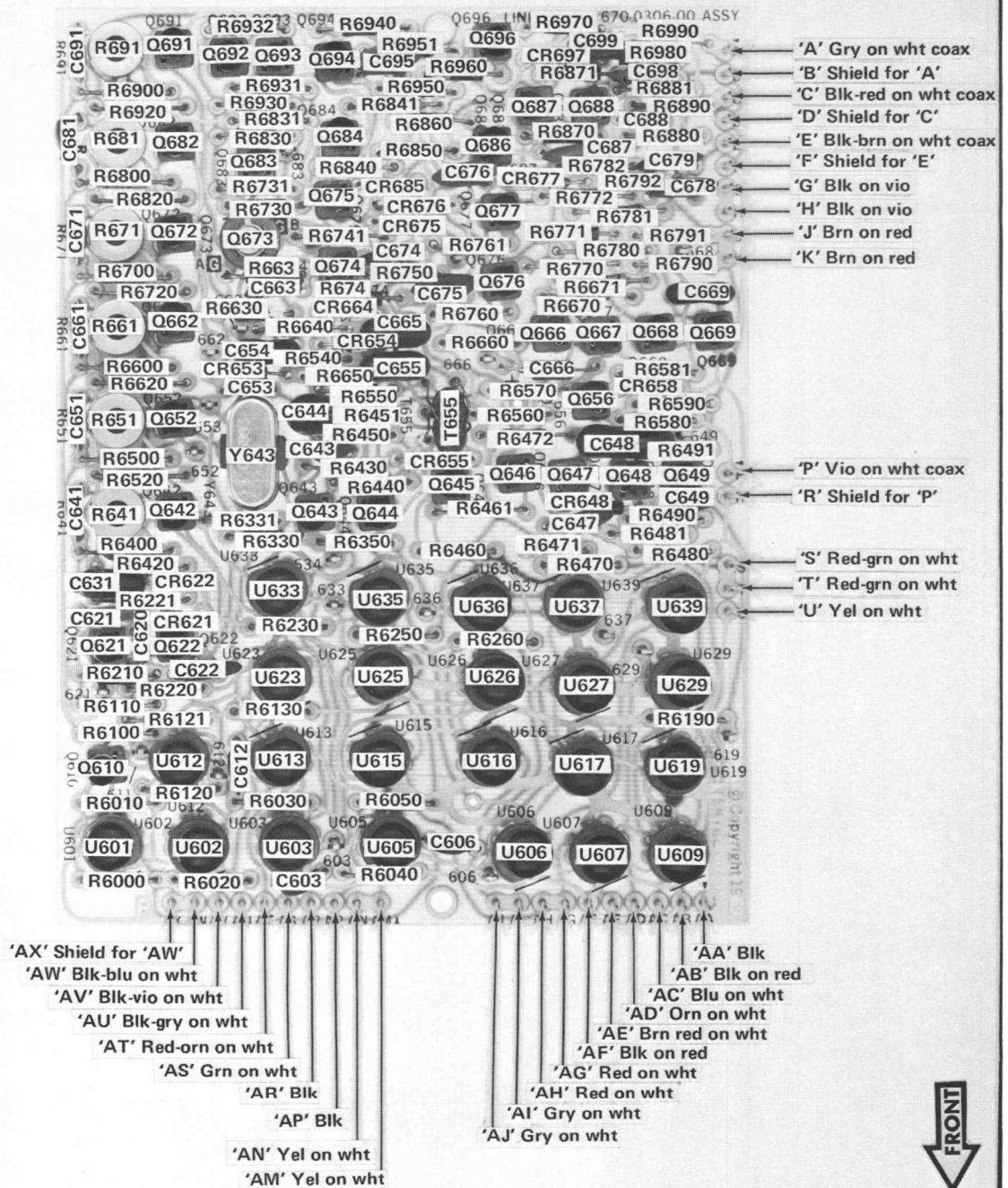


Fig. 4-12. Line Timing board; component identification and wire color code.

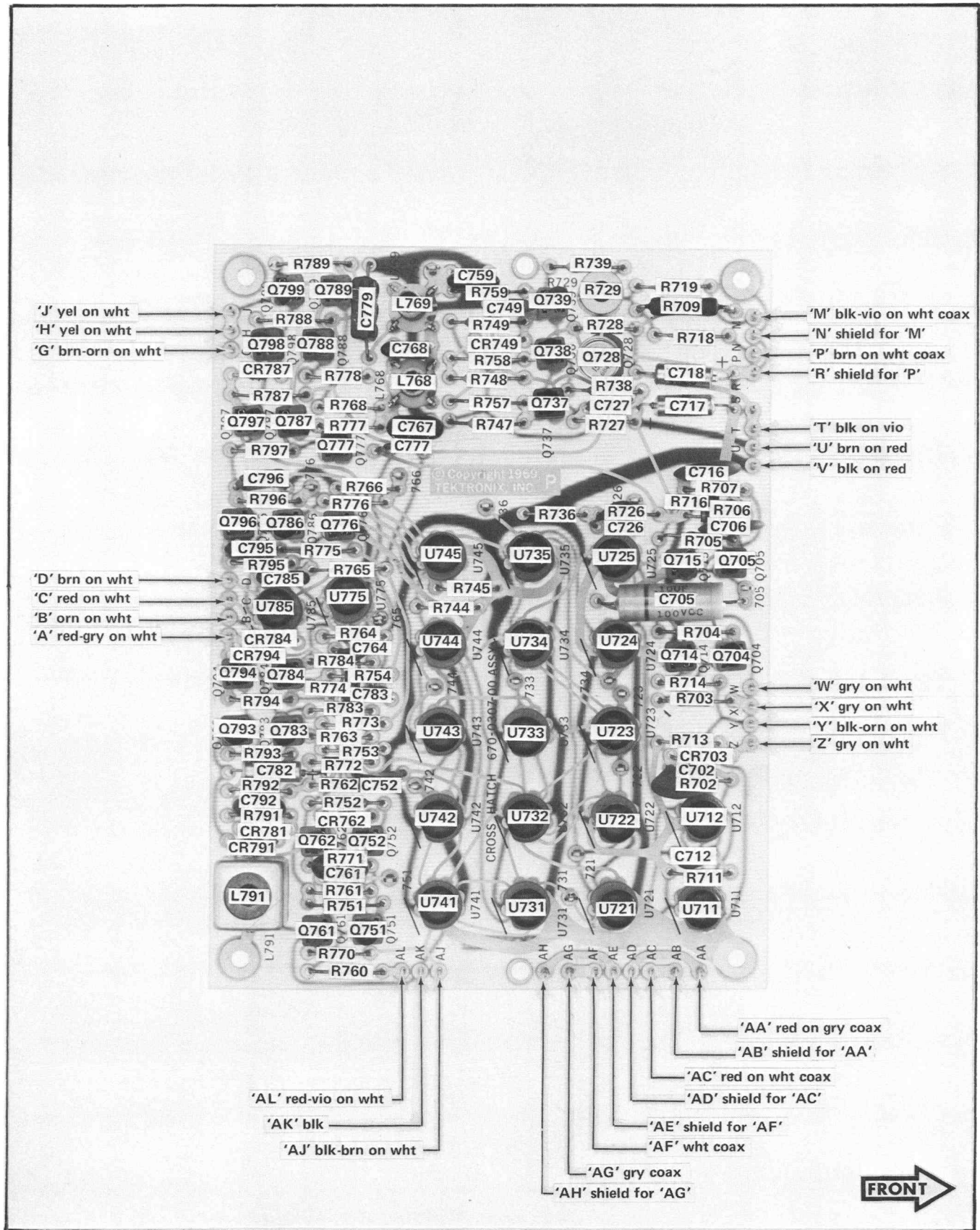


Fig. 4-13. Crosshatch and Dot Generator board; component identification and wire color code.

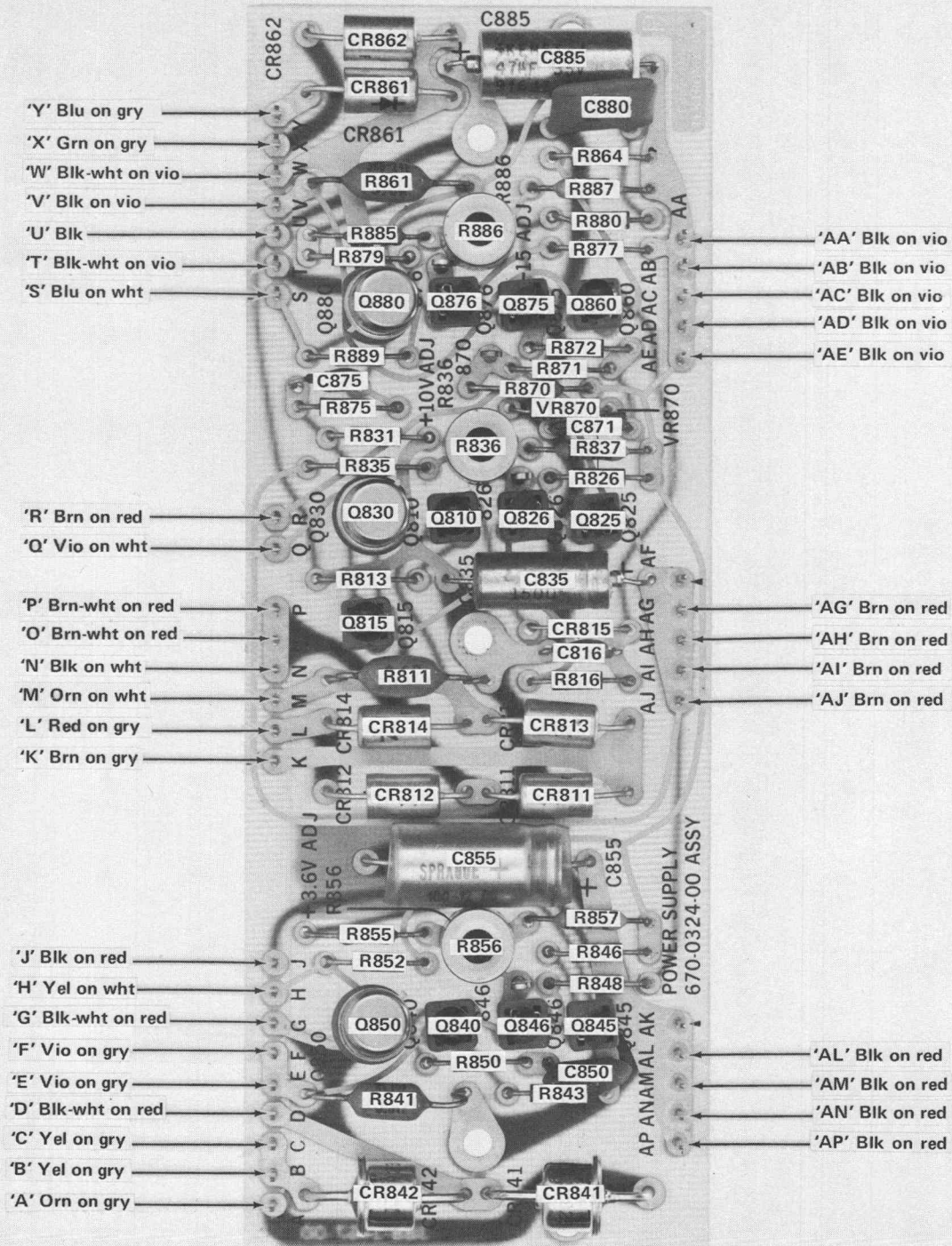


Fig. 4-14. Power Supply board; component identification and wire color code.

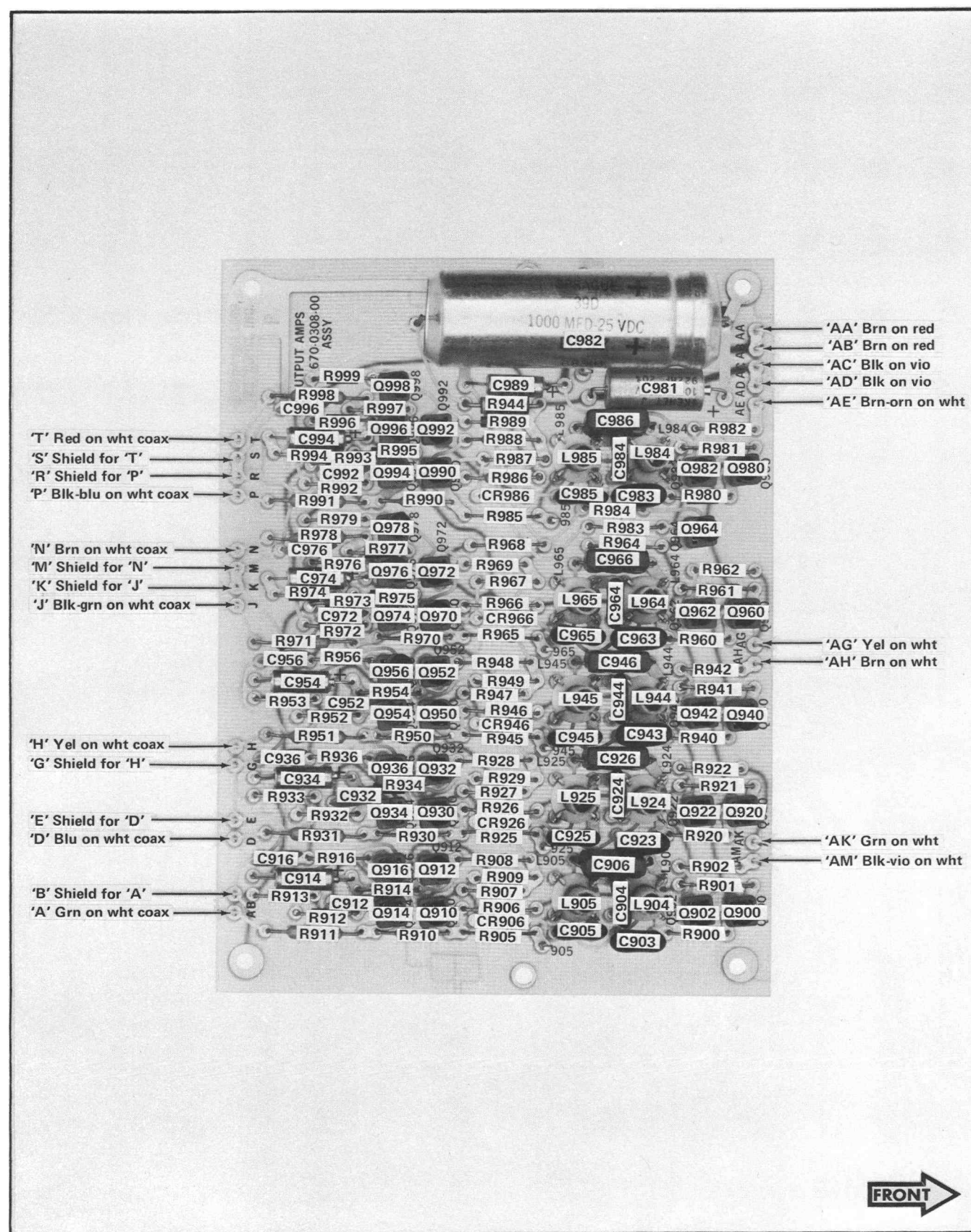


Fig. 4-15. Output Amplifier board; component identification and wire color code.



Fig. 4-16. Subcarrier Output board; component identification and wire color code.

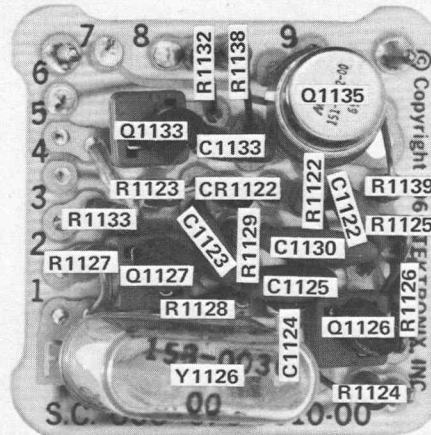


Fig. 4-17. Oscillator board; component identification.

SECTION 5

PERFORMANCE CHECK/CALIBRATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This procedure checks and/or calibrates the instrument to the performance requirements listed in the Specification section. Limits, tolerances, and waveforms in this procedure are given as calibration guides and are not instrument specifications, unless given in the Specification section. The instrument should not require frequent calibration, but an occasional adjustment will be necessary when transistors, integrated circuits, and other components are changed. Also, a periodic recalibration is desirable from the standpoint of preventive maintenance. The calibration of the instrument should be checked after every 1000 hours of operation or each six months if the instrument is used intermittently.

TEST EQUIPMENT REQUIRED

General

All of the following test equipment, or its equivalent, is required for complete calibration of the Type R140. Test equipment used is illustrated in the setup pictures for related steps in the procedure.

Specifications given are the minimum necessary for accurate calibration. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

For ease and accuracy in calibration, special calibration fixtures are used where necessary. All calibration fixtures listed are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

Equipment List

1. Precision DC Voltmeter. Accuracy, within $\pm 0.1\%$; range, 3 to 15 volts. For example, Fluke Model 825A.

2. Test Oscilloscope. Bandwidth, DC to at least 30 MHz; minimum deflection factor, 1 mV/division; DC offset voltage, 0 to 1 volt; two input channels providing choice of independent channel operation or differential operation;

sweep magnification, X100. A Tektronix Type 547 oscilloscope with a Type 1A5 Plug-In unit was used for the Performance Check/Calibration procedure.

3. Variable Autotransformer. Must be capable of supplying at least 200 volt-amperes over a voltage range of 90 to 136 volts (180 to 272 volts for 230-volt nominal line). If autotransformer does not have an AC Voltmeter to indicate output voltage, monitor output with an AC Voltmeter (RMS) with a range of at least 136 (or 272) volts. For example, General Radio W10MT3W Metered Variac Autotransformer.

4. Vectorscope. Measuring functions, differential gain and differential phase; accuracy, 0.5% and 0.1° respectively. Tektronix Type 520 or R520 Vectorscope recommended.

5. Constant Amplitude Signal Generator. Frequency, to 5 MHz; output amplitude, adjustable from about 0.5 volt to 2 volts; amplitude regulation, within 3%. Tektronix Type 191 Constant Amplitude Signal Generator recommended.

6. Electronic Digital Frequency Counter. Frequency measurement, DC to 5 MHz. For example, Hewlett-Packard Model 5245L Electronic Counter.

7. Video Signal Source. Tektronix Type 140 or R140 recommended. A Type 140 was used for the Performance Check/Calibration procedure.

8. 067-0596-00 Chopped Voltage Reference.¹ Tektronix calibration fixture 067-0596-00 recommended.

9. 011-0100-01 Voltage Step Up Termination. Tektronix Part No. 011-0100-01.

10. 015-0149-00 Return Loss Bridge. Tektronix calibration fixture 015-0149-00 recommended.

11. Probe. Attenuation, 10X; connector, BNC. Tektronix Probe, P6008 Part No. 010-0219-00 recommended (supplied with the Tektronix Type 547 oscilloscope).

¹ See "Note" following step 7g of procedure.

Performance Check/Calibration—Type 140/R140

12. Probe. Attenuation, 1X; connector, BNC. Tektronix Probe P6028 recommended. Tektronix Part No. 010-0074-00.

13. Cable (four). Impedance, 75 ohm; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0074-00.

14. Cable. Impedance, 50 ohm; length, 5 ns; connectors, GR. Tektronix Part No. 017-0502-00 (supplied with Tektronix Type 191).

15. Termination (three). Impedance, 75 ohm; connector, BNC; type, end-line; accuracy, within 3%. Tektronix Part No. 011-0102-00.

16. Termination. Impedance, 75 ohm; connector, BNC; type, feedthrough; accuracy, within 0.2%. Tektronix Part No. 011-0103-02 (supplied with Type R140).

17. Termination (two). Impedance, 75 ohm; connector, BNC; type, feedthrough; accuracy, matched to within 0.2%. Tektronix Part No. 011-0103-00 and 011-0103-01 (supplied with Tektronix 015-0149-00 calibration fixture).

18. Attenuator. Impedance, 50 ohm to 75 ohm; connectors, BNC; type, minimum loss going from a 50 ohm system to a 75 ohm system. Tektronix Part No. 011-0057-00.

19. Adapter. Connectors, BNC Male to GR. Tektronix Part No. 017-0064-00.

20. Adapter. Connectors, BNC-T; Tektronix Part No. 103-0030-00.

21. Jumper wire (3 inches long) with small insulated alligator clips. To be obtained locally. (Required only if step 43 is performed).

22. Adjustment Tools

Description	Tektronix Part No.
a. Tuning tool: Handle; nylon Insert; 0.077-inch diameter, for 5/64-inch inside hex cores.	003-0307-00 003-0310-00
b. Rod; 5 inches long, plastic, for 0.100-inch diameter powered iron hex cores.	003-0301-00
c. Adjustment tool; 1 1/2-inch shaft, 5 inches total length, plastic shaft	003-0000-00

and handle and metal screwdriver tip.

d. Screwdriver; 3/32-inch bit width,
3/32-inch diameter round shank, 5
inches long with plastic handle. 003-0192-00

CALIBRATION RECORD AND INDEX

This short-form procedure is provided to aid in checking the calibration of the Type R140. It may be used as a calibration guide by the experienced calibrator, or it may be used as a record of calibration. Since the step numbers and titles correspond to those in the complete procedure, this procedure also serves as an index to the complete calibration procedure.

SHORT FORM CALIBRATION PROCEDURE

1. Adjust Regulated Power Supplies page 5-7

Requirements: -15 volts..... $\pm 3\%$.
+3.6 volts..... $\pm 3\%$.
 ± 10 volts..... $\pm 3\%$.

2. Check Power Supply Regulation and Ripple page 5-8

Requirement: regulation; see complete procedure.

Requirements: ripple; -15 volts..... ≤ 50 mV P-P.
+3.6 volts..... ≤ 100 mV P-P.
+10 volts..... ≤ 50 mV P-P.

3. Check/Adjust Subcarrier Oscillator page 5-10

Requirement: 3.579545 MHz, ± 5 Hz.

4. Check/Adjust Subcarrier Amplitude page 5-10

Requirement: 2 volts peak to peak within 0.2 V.

5. Check External Subcarrier Inputs page 5-11

Requirement: See complete procedure.

6. Check Subcarrier Phase Control page 5-12

Requirement: One complete revolution will cause a corresponding revolution of the vectorscope display.

7. Check/Adjust Luminance Amplifier Gain page 5-13

Requirement: Blanking level to peak white, 714.3 mV within 1%.

8. Check/Adjust Sync Amplitude page 5-14
Requirement: Blanking level to sync tip, -285.7 mV within 1%.
9. Check/Adjust Luminance Amplifier DC Balance page 5-15
Requirement: Blanking level must be at 0 volts within 50 mV.
10. Check Variable IRE Amplitudes page 5-15
Requirement: 0 to 714.3 mV in 10 equal increments within 2%.
11. Check/Adjust Bar Width page 5-17
Requirement: Black bar width must be between 6.3 and 6.9 μ s.
12. Adjust R-Y and B-Y Modulator Filters page 5-19
Requirement: See complete procedure.
13. Check/Adjust Carrier Balance page 5-20
Requirement: Chrominance on blanking level must be ≤ 2.5 mV peak to peak.
14. Check/Adjust R-Y 180° Phase Switcher page 5-21
Requirement: Dots must overlay within 0.5° as measured on the vectorscope.
15. Check/Adjust Modulator Quadrature Phasing page 5-22
Requirement: Chrominance bars must overlay within 10 mV (using the Voltage Step Up Termination).
16. Check/Adjust Spurious Subcarrier page 5-22
Requirement: 3.58 MHz aberration between burst and the first color bar must be equal to or less than 32 mV peak to peak.
17. Adjust Modulator Output Filter page 5-23
Requirement: See complete procedure.
18. Check/Adjust Chrominance Amplifier page 5-25
Requirement: See complete procedure.
19. Check APL Subcarrier Modulation Amplitude page 5-26
Requirement: Modulated subcarrier must be 30 mV peak to peak within 1.5 mV for ≈ 13.2 μ s, 305 mV peak to peak within 3% for ≈ 13.2 μ s, 610 mV peak to peak within 3% for ≈ 13.2 μ s, and at 30 mV peak to peak within 1.5 mV for ≈ 13.2 μ s.
20. Check Chrominance Amplitudes page 5-27
Requirement: See complete procedure.
21. Adjust Chrominance Amplitudes page 5-30
Requirement: See complete procedure.
22. Check/Adjust Burst Amplitude page 5-31
Requirement: 285.7 mV peak to peak within 3%.
23. Check/Adjust Setup Level page 5-32
Requirement: 71.4 mV within 1%.
24. Check/Adjust Color Bar Luminance Levels page 5-32
Requirement: See complete procedure.
25. Check/Adjust Full Field White Risetime and Aberrations page 5-33
Requirements: Aberrations..... $\leq 2\%$ of a 5 cm display.
Risetime.....115 ns within 15%.
26. Check/Adjust Split Field Timing page 5-34
Requirements: Falltime of Split Field Blue bar must be coincident with the falltime of the -I, W, Q, B black bar.

I, W, Q, B white bar must fall at the midpoint of the Split Field cyan bar within 1%.
27. Check/Adjust -I, W, Q, B White Bar Amplitude page 5-35
Requirement: 714.3 mV within 1%.
28. Check/Adjust -I, W, Q, B White Bar Aberrations page 5-35
Requirement: Aberration on white bar must be $\leq 2\%$ of a 5 cm display.

Performance Check/Calibration—Type 140/R140

- | | |
|---|---|
| <p>29. Check/Adjust —I and Q Amplitudes page 5-35</p> <p>Requirements: —I 285.7 mV within 3%.
 Q 285.7 mV within 3%
 —I, Q must be within 1%,
 relative to each other.</p> <p>30. Check/Adjust Luminance To Chro- minance Delay page 5-36</p> <p>Requirement: 20 ns or less. (See "Note" preceding step 30, part a.)</p> <p>31. Check Chrominance Risetime page 5-37</p> <p>Requirement: 375 ns within 15%. (See "Note" preceding step 30, part a.)</p> <p>32. Check/Adjust Staircase Level Amplitudes page 5-39</p> <p>Requirements: 142.86 mV within 1% between levels.
 714.3 mV within 1% from blanking level to fifth level.</p> <p>33. Check Staircase Risetime and Aberra- tions page 5-41</p> <p>Requirements: Risetime 260 ns within 15%.
 Aberrations $\leq 2\%$ of a 5 cm display.</p> <p>34. Check/Adjust Staircase Modulation page 5-41</p> <p>Requirement: 142.86 mV within 3%.</p> <p>35. Check Staircase Modulation Duration and Delay page 5-42</p> <p>Requirements: Duration 40 μs within 5%.
 Delay 16.1 μs within 5%.</p> <p>36. Check/Adjust Line Timing page 5-43</p> <p>Requirement: See complete procedure.</p> <p>37. Check VITS and Selectable APL page 5-45</p> <p>Requirement: See complete procedure.</p> <p>38. Check/Adjust Output Amplifiers page 5-47</p> <p>Requirement: See Complete procedure.</p> <p>39. Check/Adjust Convergence Amplitudes page 5-48</p> <p>Requirements: Sync tip to pulse peak 1 volt within 5%.
 Pulse 714 mV within 5%.
 Sync 286 mV within 5%.
 Setup 72 mV within 5%.</p> | <p>40. Check/Adjust Crosshatch Vertical Lines page 5-49</p> <p>Requirement: See complete procedure.</p> <p>41. Check Crosshatch Horizontal Lines page 5-50</p> <p>Requirement: See complete procedure.</p> <p>42. Check/Adjust Convergence Risetime page 5-51</p> <p>Requirement: 115 ns within 10%.</p> <p>43. (Calibration Procedure Only) Check Instrument Return Loss page 5-53</p> <p>Requirement: Outputs At least 30 dB.
 Inputs
 SUBCARRIER—At least 46 dB at 3.58 MHz.
 COMP SYNC—At least 46 dB.</p> <p>44. Check Jitter page 5-55</p> <p>Requirement: ≤ 4 ns.</p> <p>45. Check Diff Gain and Diff Phase page 5-55</p> <p>Requirement: Diff Gain $\leq 0.5\%$ at 10, 50, and 90 APL.
 Diff Phase $\leq 0.1^\circ$ at 10, 50, and 90 APL.</p> <p>46. Check Color Bar Vectors page 5-57</p> <p>Requirement: See complete procedure.</p> |
|---|---|

PERFORMANCE CHECK/ CALIBRATION PROCEDURE

General

The following procedure is arranged in a sequence designed for checking or calibration with minimum interaction of adjustments and reconnection of equipment. However, some adjustments affect the calibration of other circuits within the instrument, and it may be necessary to check the operation of other parts of the instrument. When a step interacts with others, the steps which need to be checked are noted in the "INTERACTION" step.

NOTE

If adjustments are made on the power supplies, the calibration of the entire instrument must be checked.

Do not preset internal controls unless the instrument has been repaired or is known to be seriously out of adjustment. If repairs have been made, preset internal controls to midrange in the affected circuits.

Steps titled "CHECK" or "CHECK/ADJUST" are a combined Performance Check and Calibration procedure. (Exception: step 43 is a calibration procedure only.) When performing a Performance Check only, do not do the "ADJUST" portion of the step. For convenience, the actual "ADJUST" portions of the steps are printed in red. Steps titled "ADJUST" are used only with a complete Calibration of the instrument.

The symbol **①** is used to identify the steps in which an adjustment is made. To prevent recalibration of other circuits when performing a partial calibration, readjust only if the listed tolerance is not met. However, when performing a complete calibration, best overall performance will be provided if each adjustment is made to the exact setting.

In the following procedure, a test equipment setup picture is shown for each major group of adjustments and checks. Near each setup picture is a complete list of front-panel control settings for the Type R140. To aid in locating individual controls which have been changed during the complete Performance Check and/or Calibration, these control names are printed in bold type. If only a Partial Performance Check and/or Calibration is performed, start with the preceding setup. (All test equipment and connections are disconnected). Type R140 front-panel and rear-panel control titles and output connectors are capitalized (e.g., COMP SYNC). Internal adjustment titles are initial capitalized only (e.g., Bar Width). Unless stated otherwise, all connections are made to the Type R140 front-panel connectors.

The following procedure uses the equipment and fixtures previously listed in this section of the manual. If equipment and fixtures are substituted, control settings or test equipment setup may need to be altered to meet the requirements of the equipment used.

NOTE

All waveforms shown in this procedure are actual photographs taken with a Tektronix Oscilloscope Projected Graticule Camera System.

Preliminary Procedure

1. (Calibration Procedure only) Remove the Type R140 from any enclosure so as to provide access to all internal adjustments and test points, including rear-panel connectors. (Exception: see Steps 30 and 31).
2. (Calibration Procedure only) Lay the Type R140 on its side for access to the Power Supply board.
3. Connect the autotransformer to a suitable power source and the Type R140 to the autotransformer output.
4. Set the autotransformer output voltage to the design center voltage for which the Type R140 LINE VOLTS selector switch has been set.
5. Set the Type R140 POWER switch to ON. Allow at least 20 minutes warmup at 25°C, ±5°C before checking and/or calibrating the instrument to the given accuracy.
6. Set the Type R140 and test equipment controls as described following Fig. 5-1.

NOTES

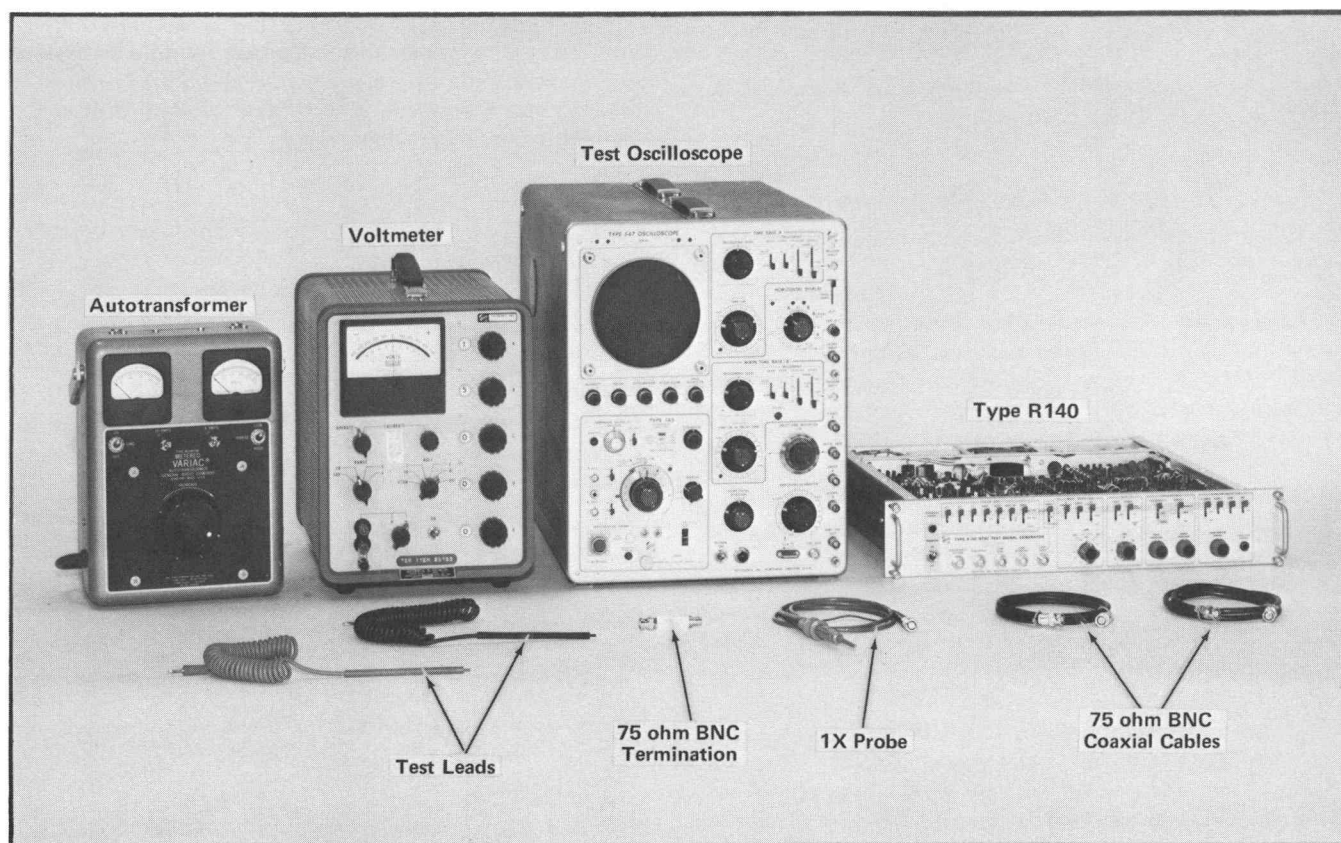


Fig. 5-1. Test equipment required for steps 1 and 2.

Type R140 Controls		Test Oscilloscope Controls	
COLOR BAR		VERT POSITION	Midrange
R-Y	Up	HORIZ POSITION	Midrange
B-Y	Up	SYNCHRONIZATION	
Y	Up	B-Y PHASE	90°
AMPL	75%	BURST	Up
SETUP	10%	SYNC	Up
WHITE REF	Up	REF	Up
BARS	FULL FIELD	SUBCARRIER PHASE	As is
VIDEO	Up	POWER	
MOD STAIRCASE		ON	
0° SUBCARRIER	Up	Test Oscilloscope Controls	
STEPS	Up	Viewing	
90° SUBCARRIER	OFF	Intensity	As desired
APL/IRE LEVEL	50%	Focus	As desired
VITS		Astigmatism	As desired
FIELD	1	Scale Illum	As desired
SIGNAL	MOD STAIRCASE	Trace Separation	0
LINE	15	Time Base A	
CONVERGENCE		Triggering Level	Near 0, pushed in
CROSSHATCH	ON	Triggering	
DISPLAY	CROSSHATCH	Mode	Trig

Slope	—
Coupling	DC
Source	Ext
Time/Cm	20 μ s
Variable (Time/Cm)	Calibrated
Time Base B	Not Used
Horizontal Display	A
Sweep Magnifier	Off
Single Sweep	Normal
Delay-Time Multiplier	Not used
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	GND
B Input AC-GND-DC	GND
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-Vc
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

1. Adjust Regulated Power Supplies



- a. Test equipment is shown in Fig. 5-1.
- b. Connect the common lead of the voltmeter to a convenient chassis ground point on the Type R140. Then, connect the positive lead to the junction of R887 and C885 (–15 volts) on the Power Supply board (see Fig. 5-2).
- c. CHECK—Voltmeter reading; must be –15 volts within 3%.
- d. ADJUST— –15 Volt Adj, R886, for a voltmeter reading of –15 volts.
- e. Disconnect the voltmeter lead from the junction of R887 and C885 and reconnect it to the junction of R855 and C855 (+3.6 volts).
- f. CHECK—Voltmeter reading; must be +3.6 volts within 3%.
- g. ADJUST— +3.6 Volt Adj, R856, for a voltmeter reading of +3.6 volts.

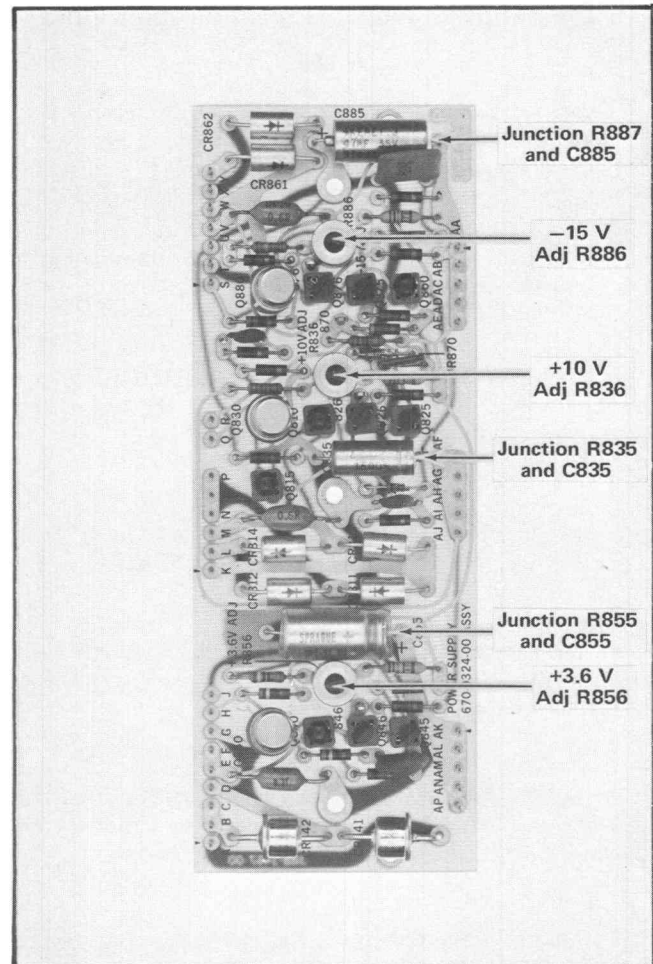


Fig. 5-2. Power Supply board test point and adjustment locations.

- h. Disconnect the voltmeter lead from the junction of R855 and C855 and reconnect it to the junction of R835 and C835 (+10 volts).

- i. CHECK—Voltmeter reading; must be +10 volts within 3%.

- j. ADJUST— +10 Volt Adj, R836, for a voltmeter reading of +10 volts.

- k. Repeat parts b through j to remove any interaction of adjustments.

- l. Disconnect the voltmeter.

- m. INTERACTION—May affect the operation of other circuits.

2. Check Power Supply Regulation and Ripple

NOTE

Tolerances for this step are not instrument specifications; rather, they are guides to determine whether complete instrument calibration is needed.

a. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.

b. From the Type R140 rear panel HORIZ DRIVE connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.

c. Set the Type 1A5 A Input AC-GND-DC switch to DC.

d. Set the test oscilloscope Time Base A Trigger Level control for a triggered display, and the viewing controls for a sharply focused and well defined display.

e. Rotate the test oscilloscope Horizontal Position control and the Type 1A5 Position control to center the display on the test oscilloscope.

f. Set the Type 1A5 Volts/Cm switch to .1 V and the Variable (Volts/Cm) control for a display amplitude of 6 cm, as measured on the test oscilloscope, between the most positive and most negative excursions of the display.

g. CHECK—Test oscilloscope display; note stability and amplitude.

h. Set the autotransformer output voltage to the lower voltage listed for the LINE VOLTS selector position being used.

i. CHECK—Test oscilloscope display; amplitude and/or stability of the display must not have changed from that noted in part g.

j. Set the autotransformer output voltage to the higher voltage listed for the LINE VOLTS selector position being used.

k. Repeat part i, then return the autotransformer output voltage to the design center voltage listed for the LINE VOLTS selector position being used.

NOTE

For Performance Check, proceed to Part x.

l. Set the Type 1A5 A Input AC-GND-DC switch to GND, B Input AC-GND-DC switch to AC, Volts/Cm switch to 10 mV, Variable (Volts/Cm) control to Cal, and the Display switch to Vc-B.

m. Set the test oscilloscope Time Base A Time/Cm switch to 5 ms and the Triggering Switches to Auto, +, AC, and Line.

n. From the Type 1A5 B Input connector, connect a 1X probe to the junction of R887 and C855 (–15 V) on the Type R140 Power Supply board; see Fig. 5-2.

o. CHECK—Test oscilloscope display; amplitude must be ≤ 50 mV peak to peak.

p. Repeat parts (in listed order) h, o, j, and o.

q. Disconnect the 1X probe from the junction of R877 and C855 and reconnect it to the junction of R855 and C855.

r. Repeat parts (in listed order) t, o, h, and o.

s. Disconnect the 1X probe from the junction of R855 and C855 and reconnect it to the junction of R835 and C835.

t. Set the autotransformer output voltage to the design center voltage being used.

u. Set the Type 1A5 Volts/Cm switch to 20 mV.

v. CHECK—Test oscilloscope display; amplitude must be ≤ 100 mV peak to peak.

w. Repeat parts (in listed order) h, v, j, and v.

x. Disconnect all test equipment; connect the Type R140 directly to a suitable power source.

Type R140 Controls

COLOR BAR	
R-Y	Up
B-Y	Up
Y	Up
AMPL	75%
SETUP	10%
WHITE REF	Up
BARS	FULL FIELD
VIDEO	Up
MOD STAIRCASE	
0° SUBCARRIER	Up
STEPS	Up
90° SUBCARRIER	Off
APL/IRE LEVEL	50%
VITS	
FIELD	1
SIGNAL	MOD STAIRCASE
LINE	15
CONVERGENCE	
CROSSHATCH	ON
DISPLAY	CROSSHATCH
VERT POSITION	Midrange
HORIZ POSITION	Midrange
SYNCHRONIZATION	
B-Y PHASE	90°
BURST	Up
SYNC	Up
REF	Up
SUBCARRIER PHASE	As is
POWER	ON

Test Oscilloscope Controls

Viewing	As desired
Time Base A	
Triggering Level	Near 0, pushed in
Triggering Mode	Trig
Slope	—
Coupling	DC
Source	NORM
Time/Cm	.1 μ s
Variable (Time/Cm)	Calibrated

Time Base B	Not used
Horizontal Display	A
Sweep Magnifier	Off
Single Sweep	Normal
Delay-Time Multiplier	Not used
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	AC
Volts/Cm	.5 V
Variable (Volts/Cm)	Cal
Display	A-Vc
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

Frequency Counter Controls

Set so that a 2 V peak to peak 3.575945 MHz signal may be counted.

Vectorscope Controls

Signal Selector	CH A, FULL FIELD, A ϕ
Channel A	
100%—75%—Max Gain	75%
Gain	As is
Phase	As is
A Cal	Cal
Channel B	Not used
ϕ Ref	Ext
Function Selector	Vector
Intensity	As desired
Luminance Gain	Cal
Scale Illum	As desired
Calibrated Phase	0
Power	On
Left recessed front-panel controls	As is
Right recessed front-panel controls	As is

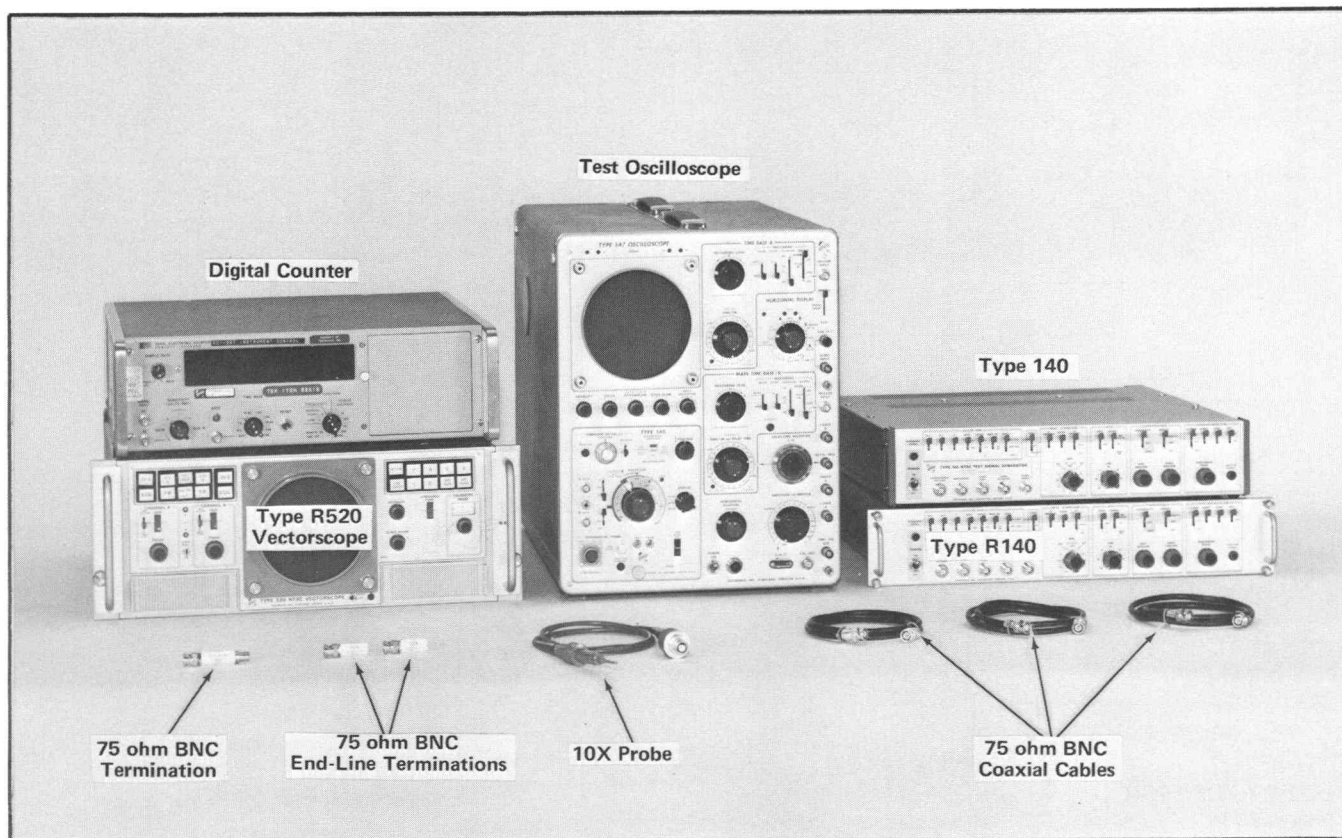


Fig. 5-3. Test equipment required for steps 3 through 6.

3. Check/Adjust Subcarrier Oscillator Frequency

- a. Test equipment is shown in Fig. 5-3.
- b. CHECK—Type R140 OVEN LIGHT; light must be on, indicating correct oven heater operation.
- c. From the Type R140 SUBCARRIER connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Digital Frequency Counter Input connector.
- d. CHECK—Frequency counter; 3.579545 MHz, ± 5 Hz.

NOTE

Parts e and f apply only as a calibration procedure. Proceed to step 4 for Performance Check.

- e. ADJUST—R1195, see Fig. 5-4, fully clockwise and fully counterclockwise; subcarrier oscillator must be adjustable from 3.579540 to 3.579550 MHz (3.579545 MHz, ± 5 Hz).

- f. ADJUST—R1195 for 3.579545 MHz.

4. Check/Adjust Subcarrier Amplitude

- a. Disconnect the 75 ohm termination from the Frequency Counter Input connector and connect it to the Type 1A5 A Input connector.
- b. Set the test oscilloscope Triggering Level control for a triggered display.
- c. CHECK—Test oscilloscope display amplitude; must be 2 volts peak to peak within 0.2 volt.
- d. Disconnect the 75 ohm coaxial cable from the Type R140 SUBCARRIER connector, and reconnect it to the rear-panel SUBCARRIER connector.
- e. Repeat part c.

NOTE

For Performance Check proceed to part m.

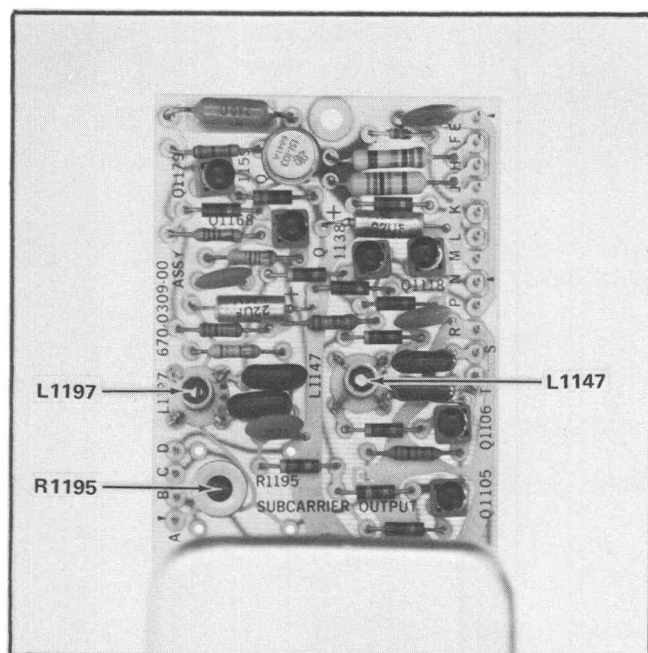


Fig. 5-4. Subcarrier Output board adjustment locations.

f. From the Type 1A5 B Input connector, connect a 10X probe to TP674 on the Type R140 Line Timing board (see Fig. 5-5).

g. Set the Type 1A5 Display Switch to Vc-B, and the Volts/Cm switch to 50 mV.

h. ADJUST—L1147 (see Fig. 5-4) for maximum signal amplitude as measured on the test oscilloscope.

i. Set the Type 1A5 Volts/Cm switch to .5 V and the Display Switch to A-Vc.

j. ADJUST—L1197 for maximum signal amplitude as measured on the test oscilloscope.

k. Repeat part c.

l. Disconnect the 10X probe from TP674 and the Type 1A5 B Input connector.

m. Set the Type 1A5 B Input AC-GND-DC switch to GND.

n. Test equipment remains connected.

5. Check External Subcarrier Inputs

a. Connect a 75 ohm coaxial cable from the Type R140 SUBCARRIER connector to the test oscilloscope Trigger Input connector.

b. Set the test oscilloscope Triggering Source switch to Ext, then rotate the Triggering Level control for a triggered display.

c. Set the Type R140 SYNCHRONIZATION REF switch to EXT.

d. CHECK—Test oscilloscope; display must not be present.

e. Connect a 75 ohm end-line termination to the Type R140 rear-panel Loop-Thru SUBCARRIER INPUT connector.

f. From another Type 140 (or signal source capable of supplying 3.579545 MHz, between 1 and 4 volts peak to peak) Subcarrier connector, connect a 75 ohm coaxial cable to the Type R140 rear-panel Loop-Thru SUBCARRIER INPUT unused connector.

g. CHECK—Test oscilloscope; display should be present and triggered.

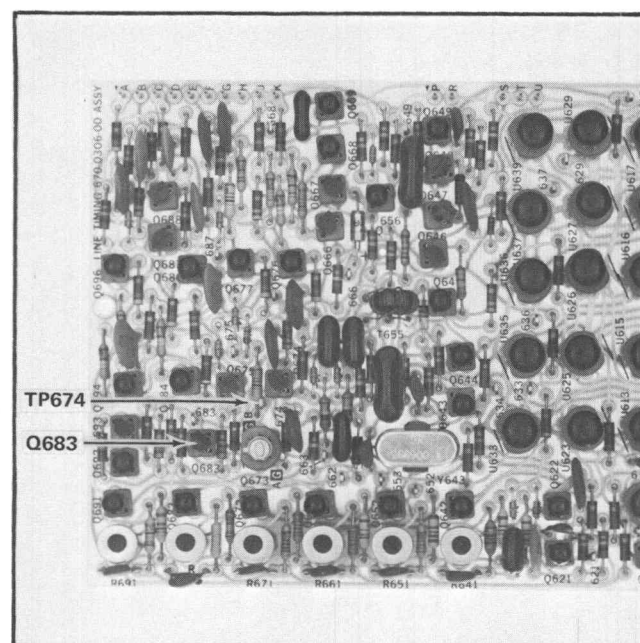


Fig. 5-5. Line Timing board test point and transistor locations.

Performance Check/Calibration—Type 140/R140

h. Reverse the 75 ohm end-line termination and the 75 ohm coaxial cable connected to the Type R140 Loop-Thru SUBCARRIER INPUT connectors.

i. Repeat part g.

j. Test equipment remains connected.

6. Check Subcarrier Phase Control

a. Disconnect the 75 ohm coaxial cable and the 75 ohm end-line termination from the Type R140 rear-panel Loop-Thru SUBCARRIER INPUT connector, and the 75 ohm termination from the Type 1A5 A Input connector.

b. Connect a 75 ohm end-line termination to the Type R520 Vectorscope Channel A J2 connector and another 75 ohm end-line termination to the Ext CW REF J311 connector.

c. Connect the 75 ohm coaxial cable from the Type R140 rear-panel SUBCARRIER connector to the Vectorscope Ext CW REF J310 connector and another 75 ohm coaxial cable from the Type R140 rear panel COMP VIDEO connector to the Vectorscope Channel A J1 connector.

d. Set the Type R140 SYNCHRONIZATION REF switch to INT.

e. Observing the Vectorscope display, rotate the Type R140 SYNCHRONIZATION SUBCARRIER PHASE control clockwise 1 revolution.

f. CHECK—Vectorscope display; display must rotate 1 complete revolution.

NOTE

Tolerances for this step are not instrument specifications.

g. Repeat parts e and f, except rotate the control in a counterclockwise direction.

h. Disconnect all test equipment.

Type R140 Controls

COLOR BAR

R-Y	Up
B-Y	Up

Y	Up
AMPL	75%
SETUP	10%
WHITE REF	Up
BARS	FULL FIELD

VIDEO

Down

MOD STAIRCASE

0° SUBCARRIER	Down
STEPS	Down
90° SUBCARRIER	Off
APL/IRE LEVEL	90%/100

VITS

FIELD	1
SIGNAL	MOD STAIRCASE
LINE	15

CONVERGENCE

CROSSHATCH	ON
DISPLAY	CROSSHATCH
VERT POSITION	Midrange
HORIZ POSITION	Midrange

SYNCHRONIZATION

R-Y PHASE	90°
BURST	Down
SYNC	Up
REF	Up
SUBCARRIER PHASE	As is
POWER	ON

Test Oscilloscope Controls

Viewing

As desired

Time Base A

Triggering Level	0, pushed in
Triggering	
Mode	Trig
Slope	—
Coupling	DC
Source	Ext
Time/Cm	10 μ s
Variable (Time/Cm)	Calibrated

Time Base B

Horizontal Display	Not used
Sweep Magnifier	A
Single Sweep	Off
Delay-Time Multiplier	Normal
Horizontal Position	As is
Vernier (Horizontal Position)	Midrange
Power	Midrange
Amplitude Calibrator	On
	Off

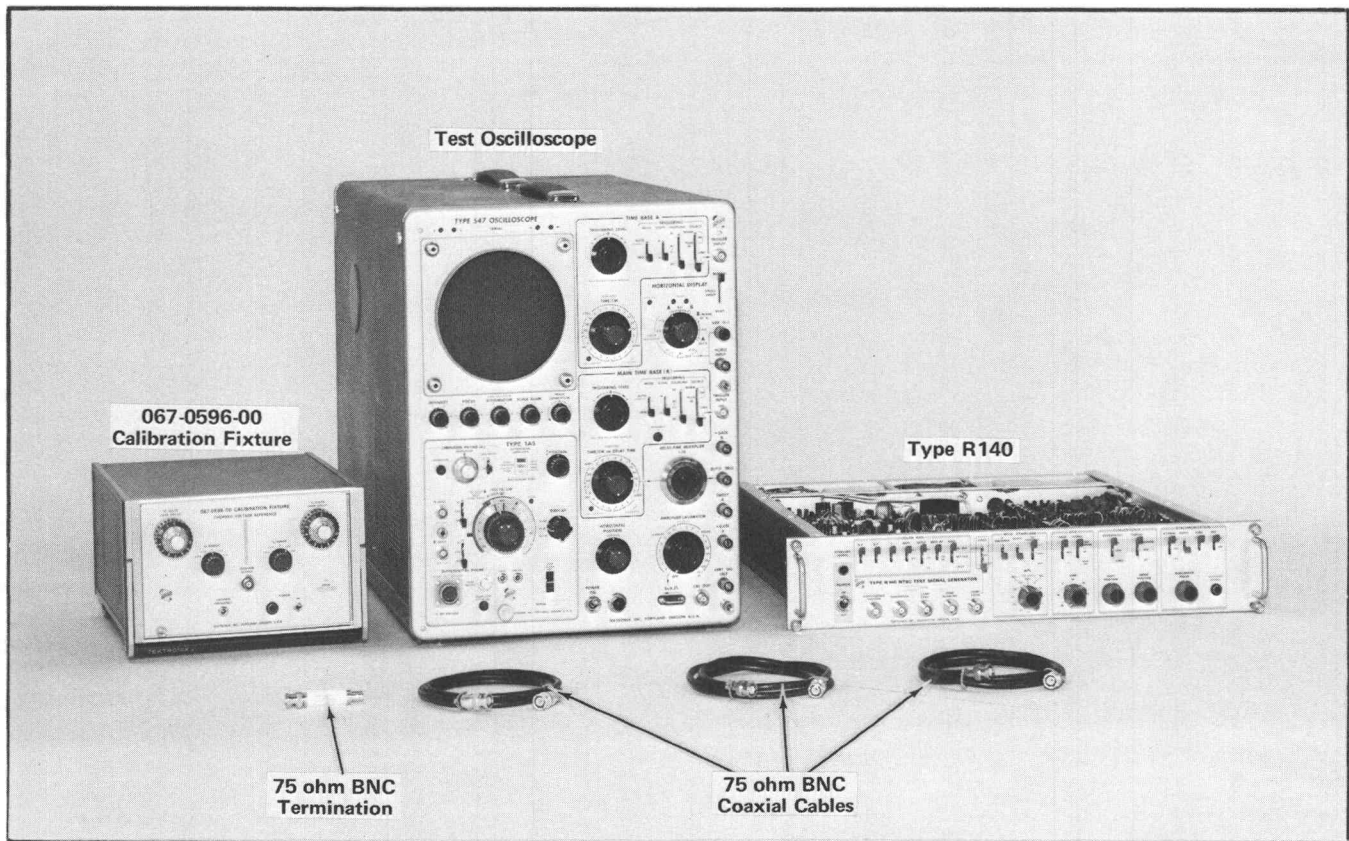


Fig. 5-6. Test equipment required for steps 7 through 11.

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	DC
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

067-0596-00 Calibration Fixture Controls

V_1	
Range	0
Volts	0-0-0
V_2	
Range	+1.1 V
Volts	2-0-0
Chopper Frequency	As is
Power	On

7. Check/Adjust Luminance Amplifier Gain

- a. Test equipment is shown in Fig. 5-6.
- b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.
- c. From the Type R140 rear-panel HORIZ DRIVE connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.
- d. From the 067-0596-00 calibration fixture Chopped Output connector, connect a 75 ohm coaxial cable to the Type 1A5 B Input connector.

- e. Rotate the test oscilloscope Time Base A Triggering Level control for a triggered display.

NOTE

The test oscilloscope displays will be separated by approximately 1 major division.

Performance Check/Calibration—Type 140/R140

f. Set the 067-0596-00 calibration fixture V_2 Volts control to 0-0-0 and note that the displays are superimposed.

g. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 7-1-75 (714.3 mV).

NOTE

For the remainder of the Performance Check/Calibration procedure, all dial settings of the 067-0596-00 calibration fixture Volts dial(s) will include an error factor. See the 067-0596-00 calibration fixture operation manual for details.

h. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the 100 IRE level line of the lower display and the blanking level of the upper display are aligned as shown in Fig. 5-7A.

i. Set the Type 1A5 Volts/Cm switch to 10 mV; repeat part h.

j. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 7-1-02 and 7-2-48 (714.3 mV, $\pm 1\%$).

k. Rotate the 067-0596-00 calibration fixture V_2 Volts control to a dial setting of 7-1-75.

l. ADJUST—Luminance Gain control, R499 (see Fig. 5-8) until the 100 IRE level line and the blanking level are aligned.

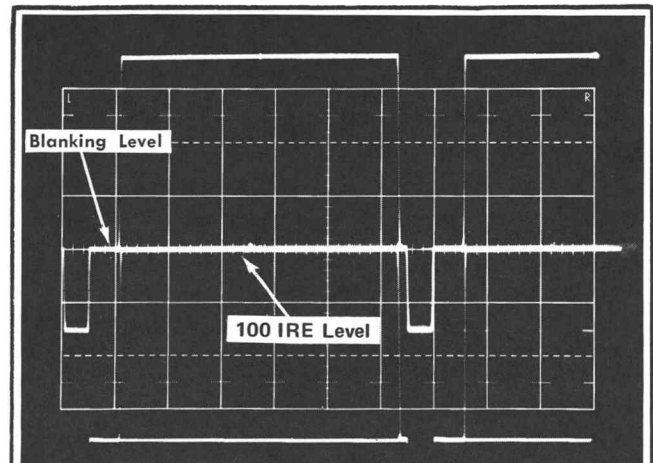
m. Test equipment remains connected.

8. Check/Adjust Sync Amplitude

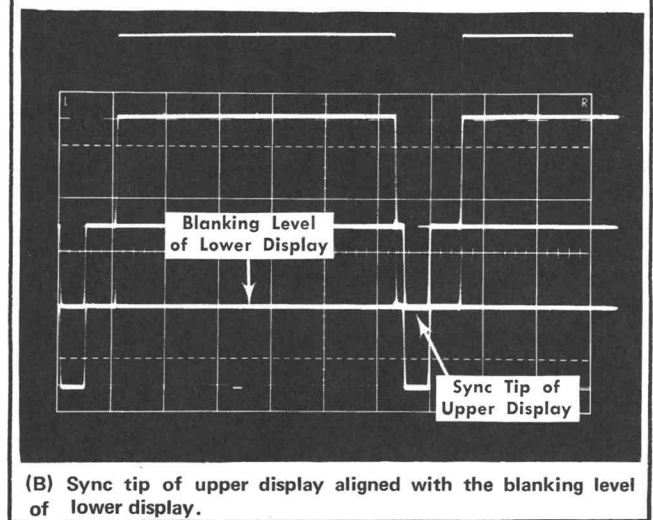
a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the 067-0596-00 calibration fixture V_2 Range switch to -1.1 V and rotate the V_2 Volts control to a dial setting of 2-8-85 (-285.7 mV).

c. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the sync tip of the upper display just aligns with the blanking level of the lower display; see Fig. 5-7B.



(A) 100 IRE level aligned with the blanking level.



(B) Sync tip of upper display aligned with the blanking level of lower display.

Fig. 5-7. Luminance and Sync Amplifiers properly adjusted.

d. Set the Type 1A5 Volts/Cm switch to 10 mV; repeat part c.

e. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 2-8-39 and 2-8-91 (285.7 mV, $\pm 1\%$).

f. Set the 067-0596-00 calibration fixture V_2 Volts control to a dial setting of 2-8-85.

g. ADJUST—Sync Amplifier control, R567, (see Fig. 5-9) until the sync tip just aligns with the blanking level.

h. Test equipment remains connected.

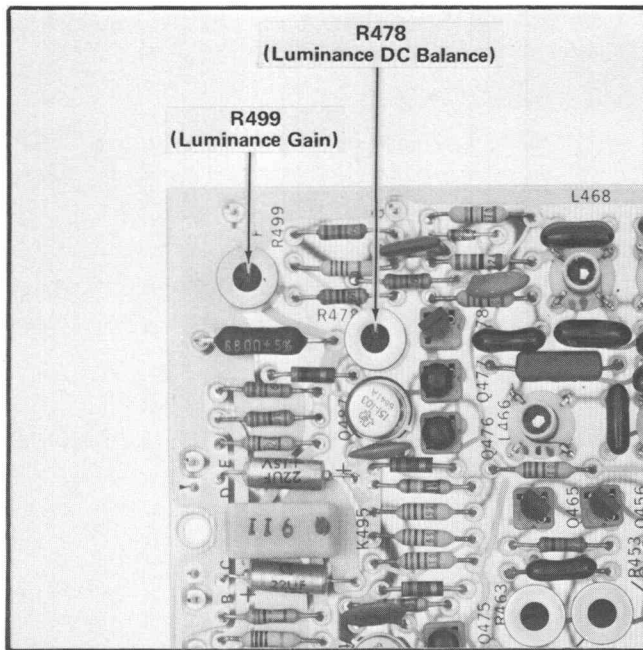


Fig. 5-8. Bar Drive and Video Output board adjustment locations.

9. Check/Adjust Luminance Amplifier DC Balance

- a. Set the Type 1A5 A and B Input AC-GND-DC switches to GND and the Volts/Cm switch to .1 V.
- b. Rotate the Type 1A5 Position control to position the trace to the center graticule line on the test oscilloscope.
- c. Set the Type 1A5 A Input AC-GND-DC switch to DC.
- d. CHECK—Test Oscilloscope display; blanking level of the display must be within 50 mV of the reference established in part b of this step.
- e. ADJUST—Luminance DC Bal control, R478, (see Fig. 5-8) until the blanking level of the display exactly coincides with the reference established in part b of this step.
- f. INTERACTION—Repeat steps 7, 8, and 9 through 9e.
- g. Test equipment remains connected.

10. Check Variable IRE Amplitude

NOTE

If any portion of step 10 is not within the listed tolerance, check and/or replace the IRE Level resistor(s), see Diagram 5. Then, perform steps 7, 8, and 9 before repeating step 10.

- a. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 10%/0.
- b. Set the 067-0596-00 calibration fixture V_2 Volts control to 0-0-0.
- c. Set the Type 1A5 B Input AC-GND-DC switch to DC, Volts/Cm switch to 10 mV, and rotate the Position control to position the blanking level of the display to the center graticule line on the test oscilloscope.
- d. Set the 067-0596-00 calibration fixture V_2 Volts control to approximately 0-7-16.
- e. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 10.
- f. Set the Type 1A5 Position control fully counterclockwise.

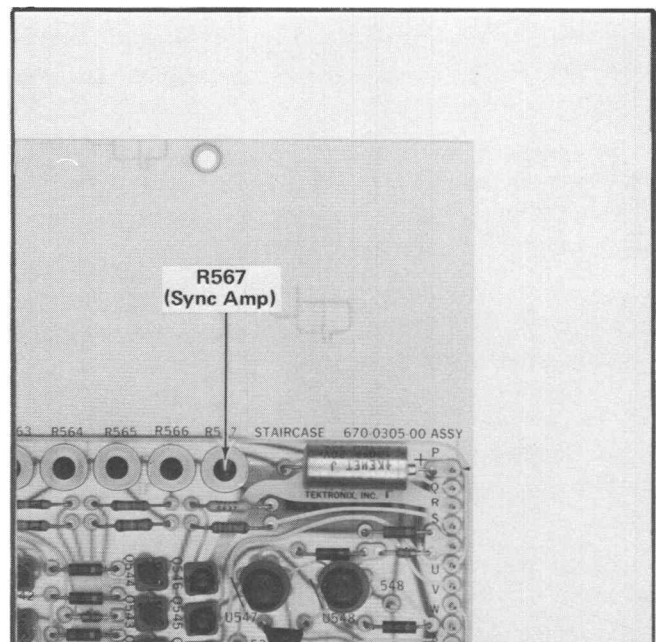


Fig. 5-9. Staircase board adjustment location.

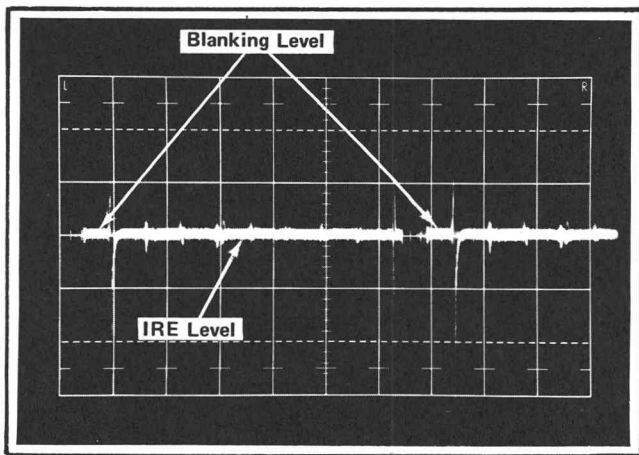


Fig. 5-10. Typical display with IRE level aligned with the blanking level.

g. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the blanking level is aligned with the 10 IRE level line as shown in Fig. 5-10.

h. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; must be between 0-7-02 and 0-7-30 (71.4 mV, $\pm 2\%$).

i. Set the 067-0596-00 calibration fixture V_2 Range switch to 0, V_1 Range switch to +1.1 V and V_1 Volts control to approximately 0-7-16.

j. Set the Type 1A5 Position control to approximately midrange.

k. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the IRE level line (as indicated by the IRE LEVEL switch setting) is aligned with the blanking level.

l. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 20.

m. Rotate the Type 1A5 Position control fully counter-clockwise.

n. Set the 067-0596-00 calibration fixture V_2 Range switch to -1.1 V.

o. Observing the test oscilloscope display, rotate the

067-0596-00 calibration fixture V_2 Volts control until the blanking level is aligned with the IRE level line.

p. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-7-02 and 0-7-30 (71.4 mV, $\pm 2\%$).

q. Set the 067-0596-00 calibration fixture V_2 Range switch to 0 and the V_1 Volts control to approximately 1-4-0.

r. Rotate the Type 1A5 Position control to approximately midrange.

s. Repeat part k.

t. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 30.

u. Repeat parts m, n, o, and p.

v. Using the procedure just described for checking the 10, 20, and 30 IRE LEVEL switch setting and Fig. 5-10, check all remaining settings of the Type R140 MOD STAIRCASE APL/IRE LEVEL switch listed in Table 5-1.

TABLE 5-1

Set APL/ IRE LEVEL switch to:	Type 1A5 Position control	067-0596-00 Calibration Fixture			Repeat part:
		V_1 Range	V_2 Range	V_1 Volts	
NC ²	Midrange	+1.1 V	0	2-1-65	k
40	CCW	NC	-1.1 V	NC	0 and p
NC	Midrange	NC	0	2-8-76	k
50	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	3-5-95	k
60	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	4-3-14	k
70	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	5-0-25	k
80	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	5-7-40	k
90	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	6-4-65	k
100	CCW	NC	-1.1 V	NC	o and p

²NC—No change from previous setting.

w. Test equipment remains connected.

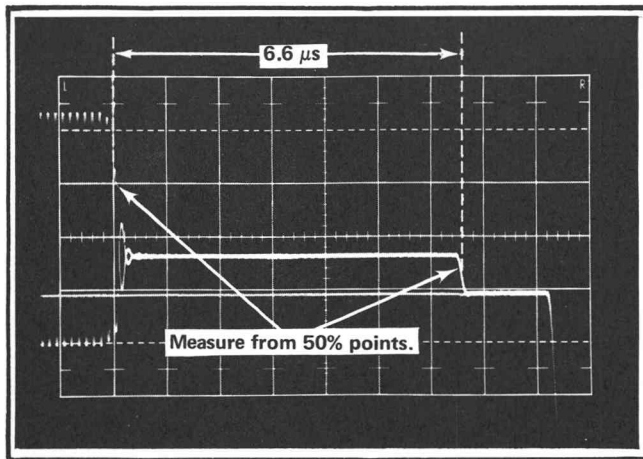


Fig. 5-11. Black bar width properly adjusted.

11. Check/Adjust Bar Width

a. Set the Type 1A5 Volts/Cm switch to .1 V, Display switch to A-Vc and the B Input AC-GND-DC switch to GND.

b. Set the Type R140 VIDEO switch up, and the SYNCHRONIZATION BURST switch up.

c. Set the test oscilloscope Horizontal Display Sweep Magnifier switch to X10 and rotate the Horizontal Position control to position the start of the black bar on a major graticule line as shown in Fig. 5-11.

d. CHECK—Test oscilloscope display, black bar width must be between 6.3 and 6.9 μ s.

e. ADJUST—Bar Width control, L217, (see Fig. 5-12) for a black bar width of 6.6 μ s.

f. Disconnect all test equipment.

Type R140 Controls

COLOR BAR

R-Y	Up
B-Y	Up
Y	Up
AMPL	75%
SETUP	10%
WHITE REF	Up
BARS	FULL FIELD

VIDEO Up

MOD STAIRCASE

0° SUBCARRIER STEPS	Up
90° SUBCARRIER	Up
APL/IRE LEVEL	Off
	50%

VITS

FIELD SIGNAL LINE	BOTH
	MOD STAIRCASE
	15

CONVERGENCE

CROSSHATCH DISPLAY	ON
VERT POSITION	CROSSHATCH
HORIZ POSITION	Midrange
	Midrange

SYNCHRONIZATION

R-Y PHASE	90°
BURST	Up
SYNC	Up
REF	Up
SUBCARRIER PHASE	As is

POWER

ON

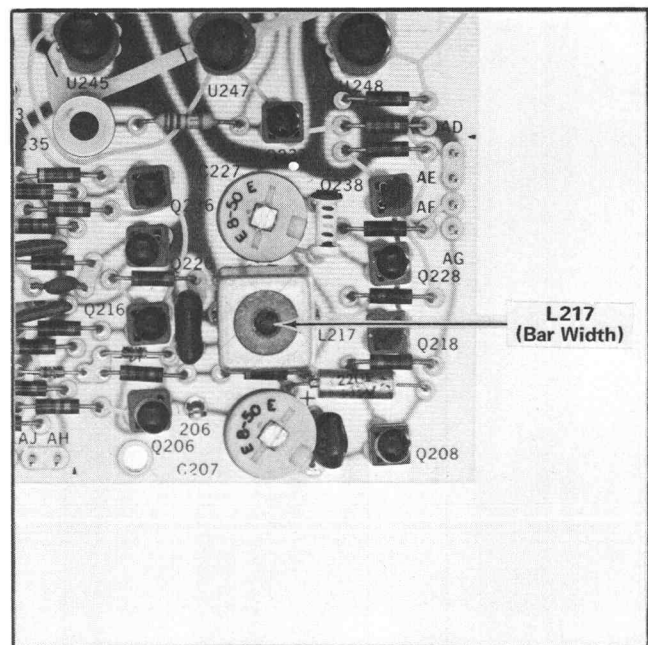


Fig. 5-12. Bar Timing board adjustment location.

Performance Check/Calibration—Type 140/R140

Test Oscilloscope Controls

Viewing	As desired
Time Base A	
Triggering Level	Near 0, pushed in
Triggering Mode	Trig
Slope	—
Coupling	DC
Source	Ext
Time/Cm	10 μ s
Variable (Time/Cm)	Calibrated
Time Base B	Not used
Horizontal Display	A
Sweep Magnifier	Off
Single Sweep	Normal
Delay-Time Multiplier	Not used
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	AC
B Input AC-GND-DC	GND
Volts/Cm	5 mV
Variable (Volts/Cm)	Cal

Display Position	A-Vc
Step Atten Bal	Midrange
Comparison Voltage	As is
Amplitude	0-0
Polarity	0

Vectorscope Controls

Signal Selector	Ch A, FULL FIELD, A ϕ
Channel A	
100%-75%-Max Gain	75%
Gain	As is
Phase	As is
A Cal	Cal
Channel B	Not used
ϕ Ref	ϕ Ref Burst
Function Selector	Vector
Intensity	As desired
Luminance Gain	Cal
Scale Illum	As desired
Calibrated Phase	0
Power	On
Left recessed front-panel controls	As is
Right recessed front-panel controls	As is

NOTES

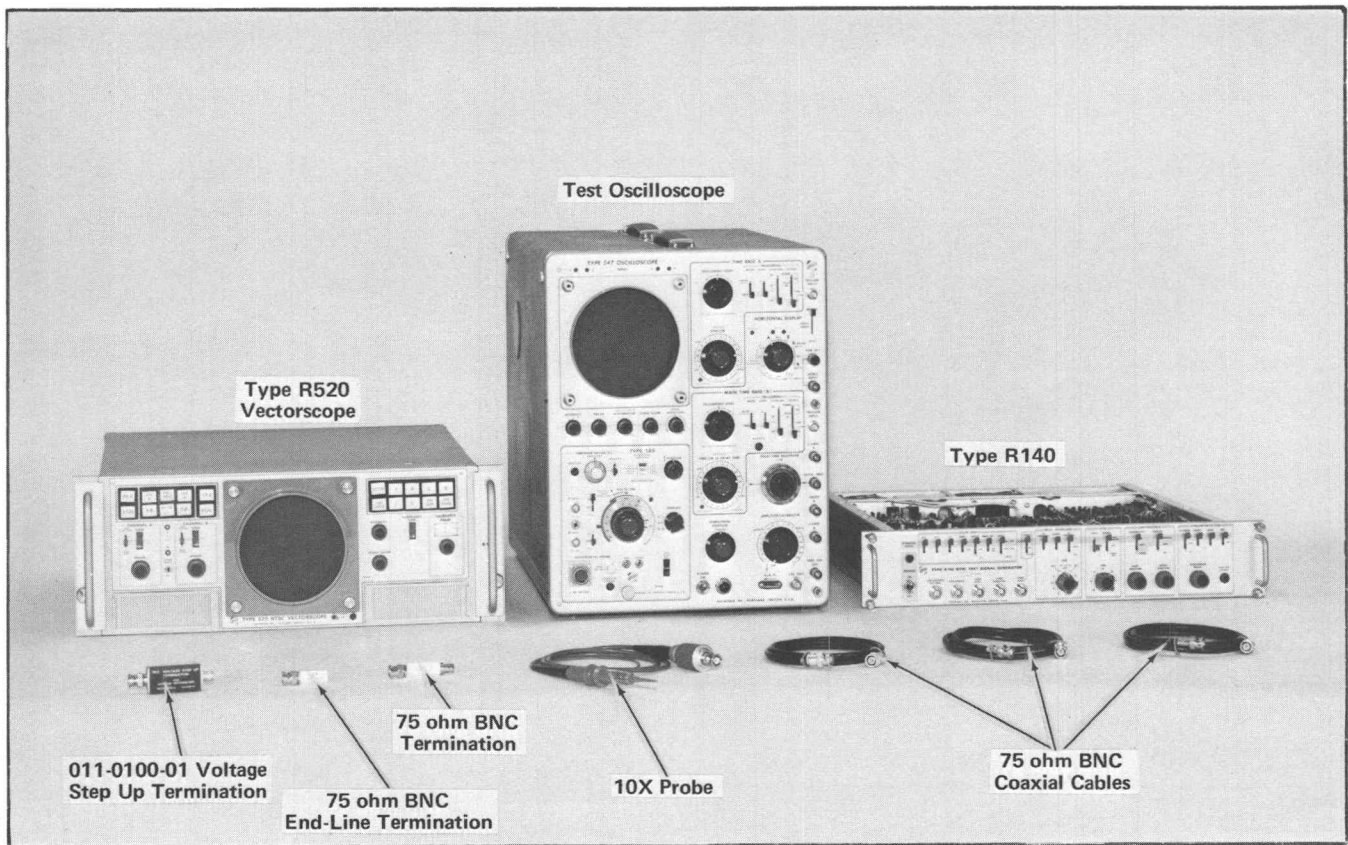


Fig. 5-13. Test equipment required for steps 12 through 17.

12. Adjust R-Y and B-Y Modulator Filters

- a. Test equipment is shown in Fig. 5-13.
- b. Connect a properly compensated 10X probe to the Type 1A5 A Input connector.
- c. From the Type R140 rear-panel COMP BLANKING connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.
- d. Connect the 10X probe tip to TP188 on the Modulator board (see Fig. 5-14).
- e. ADJUST—+(B-Y) Filter, L187, for the best square corner on the leading edges of the display as shown in Fig. 5-15A.
- f. Disconnect the 10X probe from TP188 and reconnect it to TP168.
- g. ADJUST—-(B-Y) Filter, L167, for the best square corner on the leading edges of the display as shown in Fig. 5-15B.
- h. Disconnect the 10X probe from TP168, set the Type 1A5 Volts/Cm switch to 10 mV, and then reconnect the probe to TP182.
- i. ADJUST—+(R-Y) Filter, L183, for the best square corner on the leading edges of the display as shown in Fig. 5-15C.
- j. Disconnect the 10X probe from TP182 and reconnect it to TP162.
- k. ADJUST—-(R-Y) Filter, L163, for the best square corner on the leading edges of the display as shown in Fig. 5-15D.
- l. Disconnect the 10X probe from TP162 and the Type 1A5.
- m. Test equipment remains connected.

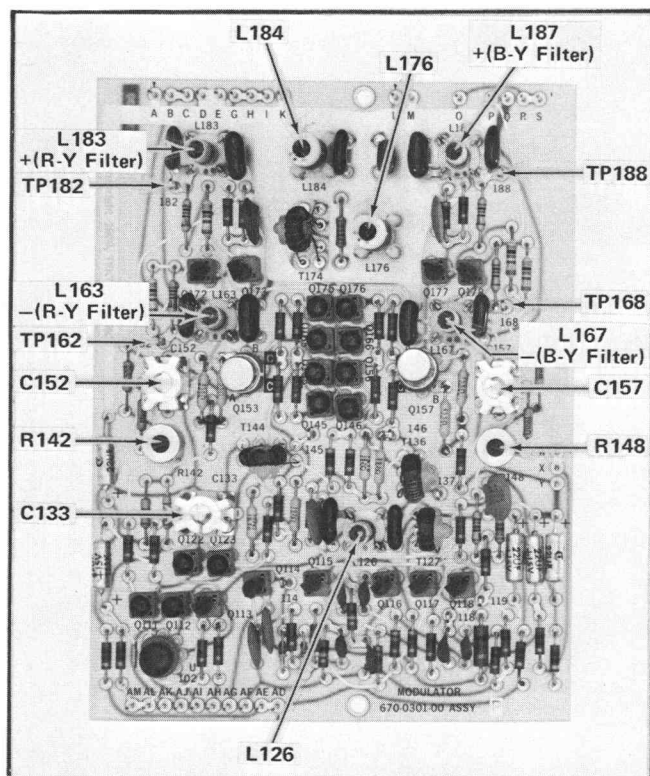


Fig. 5-14. Modulator board adjustment and test point locations.

13. Check/Adjust Carrier Balance



a. Set the Type 1A5 A Input AC-GND-DC switch to DC and the Volts/Cm switch to .2 V.

b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.

c. Observing the test oscilloscope display, rotate the Type 1A5 Position control to position the blanking level of the display to the center graticule line. Then, set the Volts/Cm switch to 2 mV.

d. Set the Type R140 COLOR BAR R-Y, B-Y and Y switches down, SETUP switch to 0%, and the SYNCHRONIZATION R-Y PHASE switch to ALT.

e. CHECK—Test oscilloscope display; amplitude of chrominance on the blanking level must be less than 2.5 mV peak to peak. It may be necessary to use the Type 1A5 Comparison Voltage Amplitude control with + Polarity to position the blanking level on the graticule. (Disregard switching transients.)

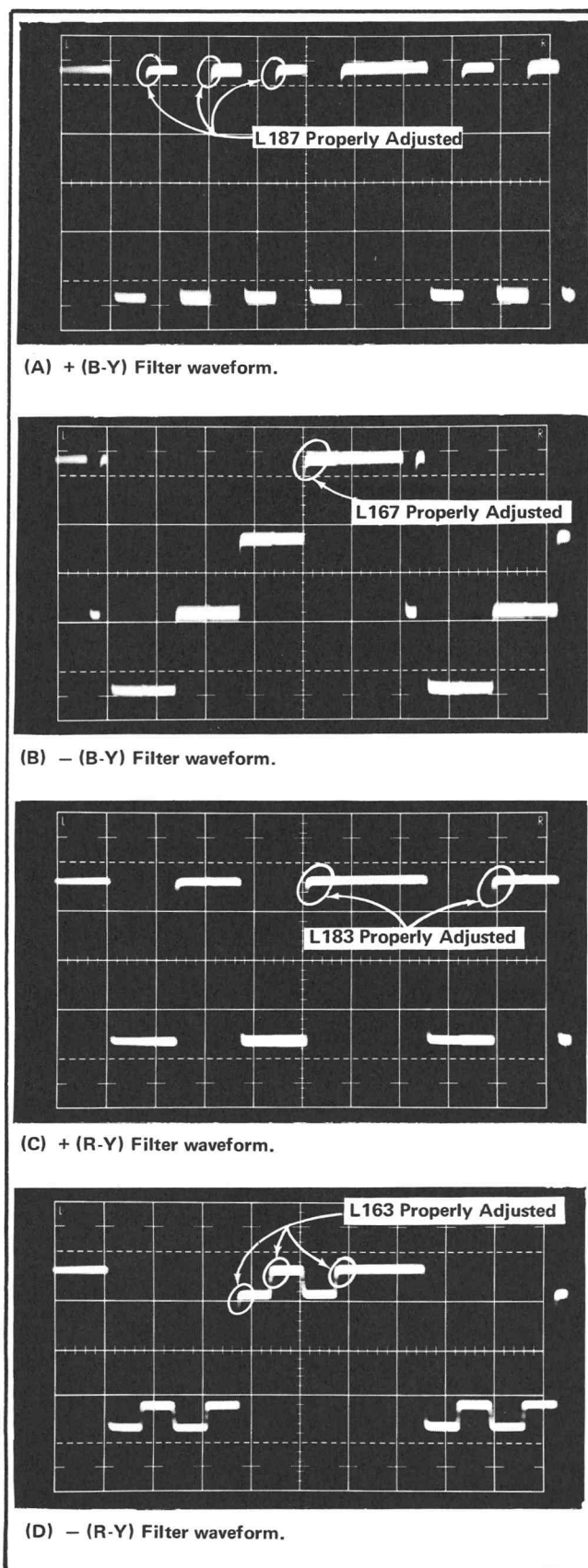


Fig. 5-15. Typical R-Y and B-Y Filter Waveforms.

NOTE

Proceed to part k for Performance Check.

f. Replace the 75 ohm termination from the Type 1A5 A Input connector with the 011-0100-01 Voltage Step Up Termination. If the Comparison Voltage Amplitude control was used in part e, set the Polarity switch to 0.

g. ADJUST—C157, R148, C152, and R142, (see Fig. 5-14) for minimum peak-to-peak chrominance on the blanking level.

h. Set the Type 1A5 Volts/Cm switch to 1 mV and repeat part g.

NOTE

C157, R148, C152, and R142 adjustments interact. Repeat the adjustments several times to obtain as absolute minimum.

i. Replace the 011-0100-01 Voltage Step Up Termination with the 75 ohm termination.

j. Repeat part e.

k. Set the Type 1A5 A Input AC-GND-DC switch to GND.

l. Test equipment remains connected.

14. Check/Adjust R-Y 180° Phase Switcher **①**

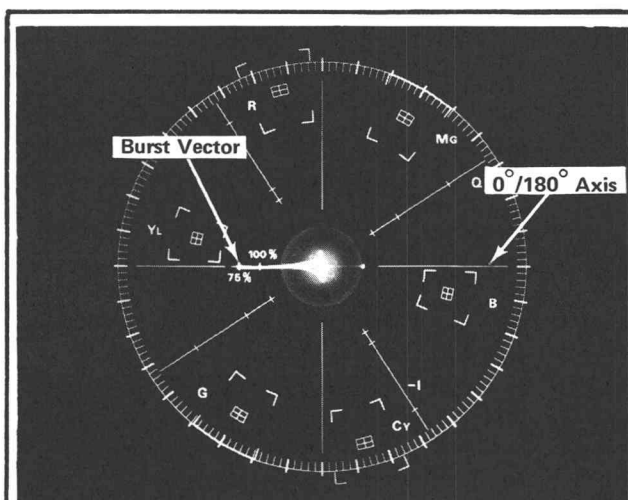
a. From the Type R140 rear-panel COMP VIDEO connector, connect a 75 ohm coaxial cable to the vectorscope CH A J1 connector.

b. Connect a 75 ohm end-line termination to the vectorscope CH A J2 connector.

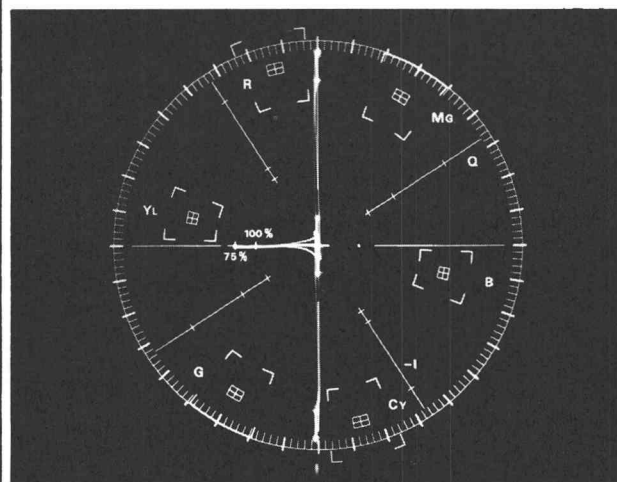
c. Observing the vectorscope display, rotate the Channel A Phase Control to align the burst vector with the 0°/180° axis as shown in Fig. 5-16A.

d. Set the Type R140 COLOR BAR R-Y switch up.

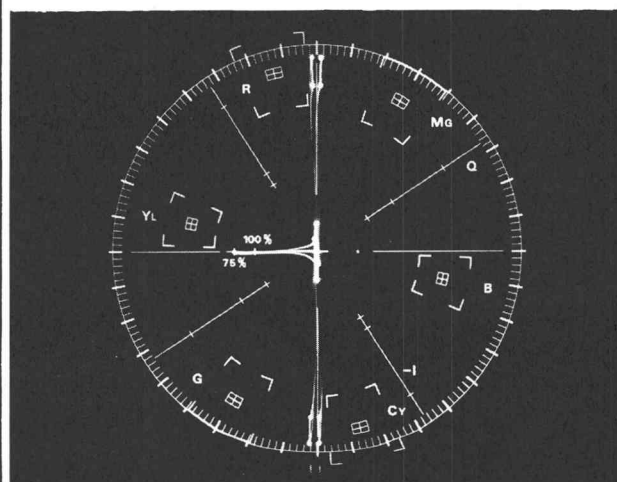
e. CHECK—Vectorscope display; dots must overlay within 0.5°; see Fig. 5-16B.



(A) Burst vector properly aligned with the 0°/180° axis of the vectorscope "Vector" graticule.



(B) R-Y 180° Phase Switcher properly adjusted.



(C) R-Y 180° Phase Switcher misadjusted.

Fig. 5-16. Typical Type 520 Vectorscope displays used to check and/or adjust the R-Y 180° Phase Switcher.

NOTE

Fig. 5-16C shows misadjustment of the R-Y 180° Phase Switcher. Use the Vectorscope Calibrated Phase dial to measure any error.

f. ADJUST—C133 (see Fig. 5-14) until the requirement of part e is met.

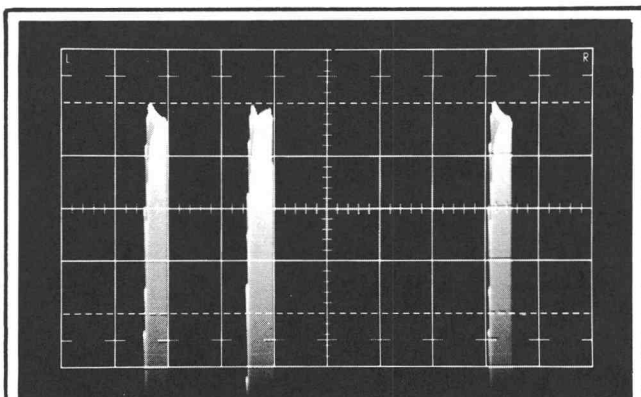
g. Set the Type R140 COLOR BAR B-Y switch up.

h. Test equipment remains connected.

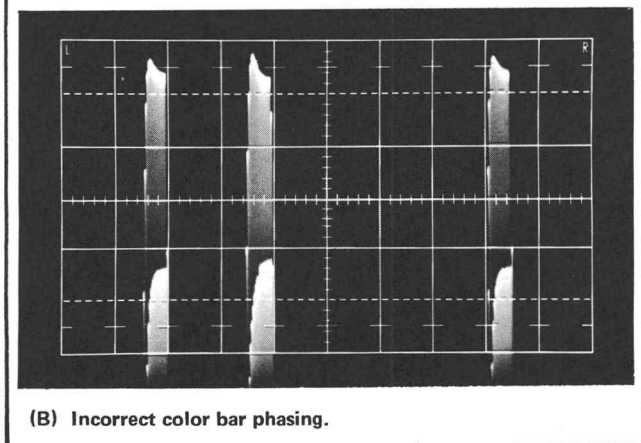
15. Check/Adjust Modulator Quadrature Phasing



a. Replace the 75 ohm termination on the Type 1A5 A Input connector with the 011-0100-01 Voltage Step Up Termination. Then, set the Volts/Cm switch to 10 mV, A Input AC-GND-DC switch to DC, Position control to mid-range, Comparison Voltage Polarity switch +, and rotate the Comparison Voltage Amplitude control to position the positive peaks of the display as shown in Fig. 5-17A.



(A) Correct color bar phasing.



(B) Incorrect color bar phasing.

Fig. 5-17. Typical displays showing correct and incorrect adjustment of color bar phasing. (Using Voltage Step Up Termination.)

b. CHECK—Test oscilloscope display; displays must overlay within 10 mV. (Typically 8 mV.)

c. Set the Type 1A5 Comparison Voltage Amplitude control to —.

d. Repeat part b using the negative peaks of the display.

e. ADJUST—L126 (See Fig. 5-14) for best color bar overlay; must be within 10 mV. (See Fig. 5-17B for improper display.)

f. Set the Type 1A5 Comparison Voltage Amplitude Polarity switch to +.

g. Repeat part e.

h. INTERACTION—If step 15 is performed out of sequence, step 13 must also be repeated before continuing.

i. Test equipment remains connected.

16. Check/Adjust Spurious Subcarrier



a. Set the Type 1A5 Volts/Cm switch to .2 V and the Comparison Voltage Polarity switch to 0. Then, replace the 011-0100-01 Voltage Step Up Termination with a 75 ohm termination.

b. Set the test oscilloscope Time Base A Time/Cm switch to 2 μ s and rotate the Horizontal Position Control to position the display horizontally on the test oscilloscope as shown in Fig. 5-18A.

c. Set the Type 1A5 Volts/Cm switch to 10 mV.

d. CHECK—Test oscilloscope display; 3.58 MHz aberration between burst and the first color bar must be less than or equal to 32 mV peak to peak; see Fig. 5-18B.

NOTE

Proceed to part k for Performance Check.

e. Set the Type R140 COLOR BAR B-Y switch down.

f. ADJUST—C422 (see Fig. 5-19) and Readjust L163 (see Fig. 5-14) for minimum 3.58 MHz aberration between burst and the first color bar.

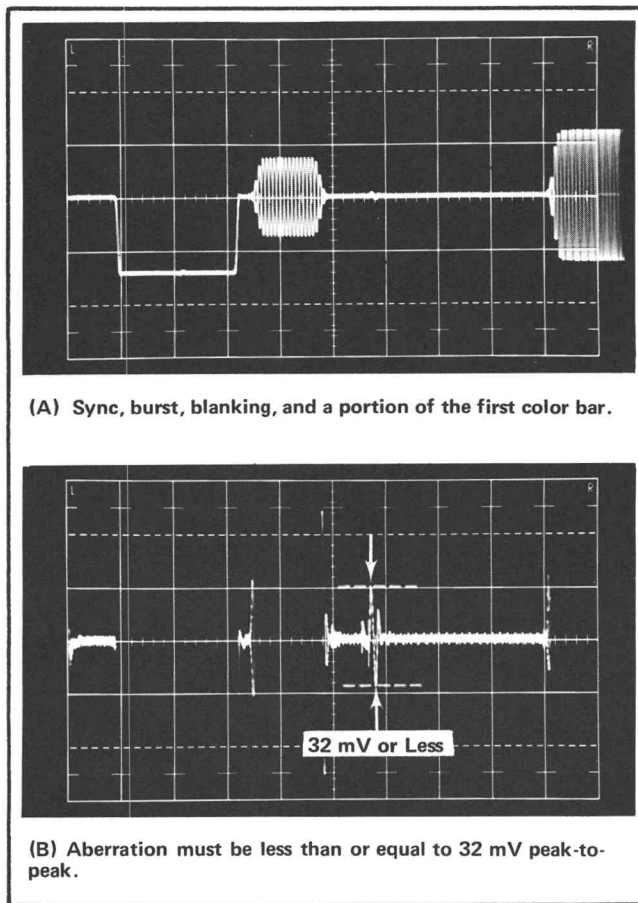


Fig. 5-18. Typical displays used to check and/or adjust spurious output.

g. Set the Type R140 COLOR BAR R-Y switch down and the B-Y switch up.

h. ADJUST—C427 (see Fig. 5-19) and Readjust L167 (see Fig. 5-14) for minimum 3.58 MHz aberration between burst and the first color bar.

i. Set the Type R140 COLOR BAR R-Y switch up.

j. Repeat part d.

k. Test equipment remains connected.

17. Adjust Modulator Output Filter

a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the test oscilloscope Time Base A Time/Cm switch to 10 μ s.

c. Observing the test oscilloscope display, rotate the Horizontal position controls to position the green-magenta transition to the center (horizontal) graticule lines as shown in Fig. 5-20A.

d. Set the test oscilloscope Sweep Magnifier switch to X10.

e. CAUTION—Pull transistor Q683, see Fig. 5-5 on the Type R140 Line Timing board.

f. ADJUST—L176 and L184 (see Fig. 5-14) for (1) best green-magenta transition; (2) best square corner on the magenta chrominance; (3) best overlay of the displays. (See Fig. 5-20B.)

g. Set the test oscilloscope Sweep Magnifier switch to Off.

h. Set the Type 1A5 Volts/Cm switch to 1 mV and rotate the Position control to position the blanking level of the display to the center graticule line; see Fig. 5-20C.

i. READJUST—L176 and L184 for less than 2.5 mV (peak to peak) of chrominance on the blanking level.

j. Set the Type 1A5 Volts/Cm switch to .2 V and rotate the Position control to approximately midrange.

k. Repeat (in listed order) parts d, f, g, h, i, and j several times to remove interaction of adjustments.

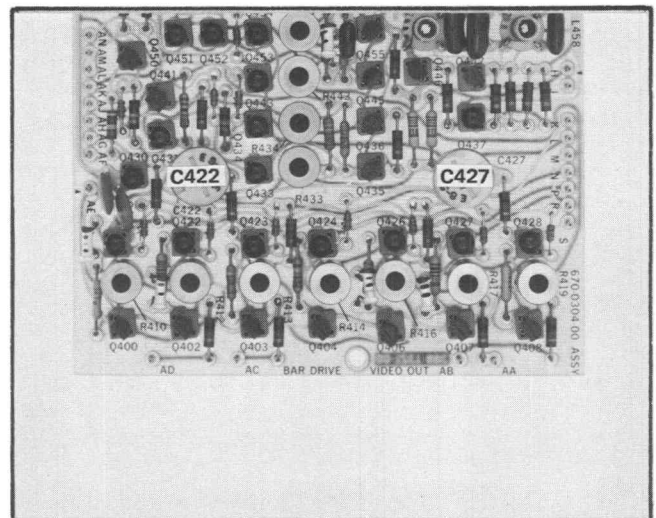


Fig. 5-19. Bar Drive and Video Out board adjustment locations.

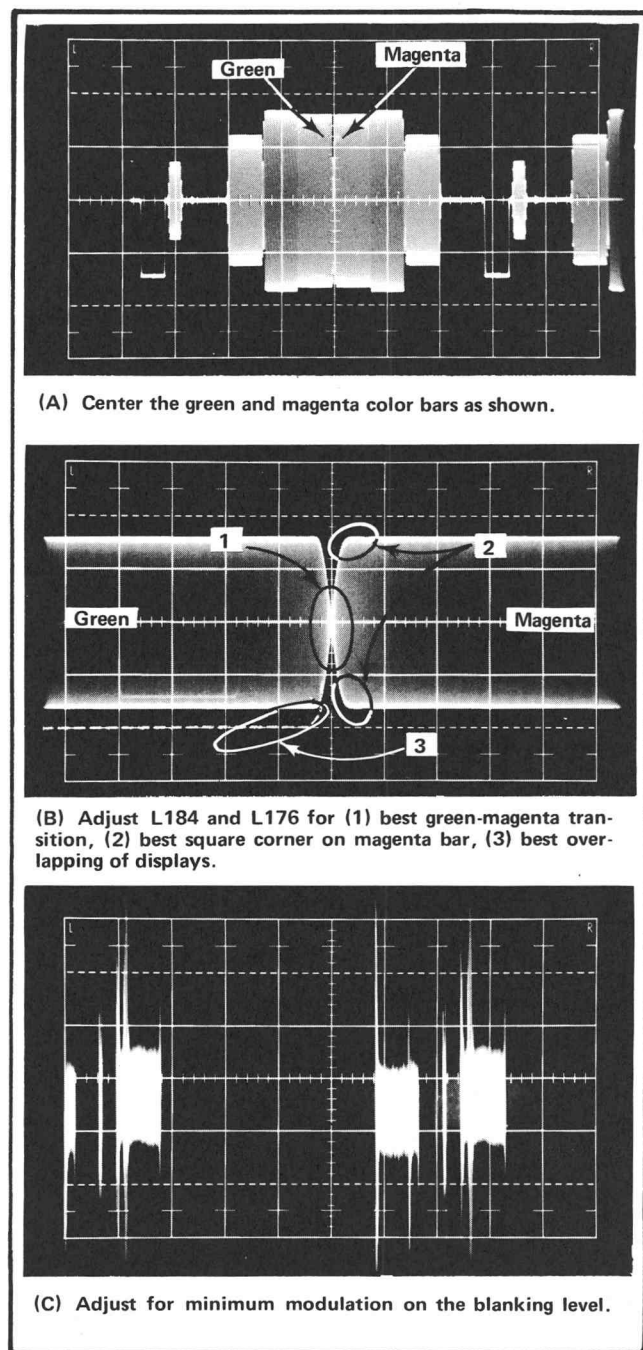


Fig. 5-20. Typical displays to adjust the Modulator Output Filter.

l. Replace Q683 removed in part e.

m. INTERACTION—Step 18 must be completed.

n. Disconnect all test equipment and connections.

Type R140 Controls

COLOR BAR
R-Y

Up

B-Y Up
Y Down
AMPL 75%
SETUP 10%
WHITE REF Up
BARS FULL FIELD

VIDEO Down

MOD STAIRCASE
0° SUBCARRIER Down
STEPS Down
90° SUBCARRIER MOD
APL/IRE LEVEL 50%

VITS
FIELD BOTH
SIGNAL MOD STAIRCASE
LINE 15

CONVERGENCE
CROSSHATCH ON
DISPLAY CROSSHATCH
VERT POSITION Midrange
HORIZ POSITION Midrange

SYNCHRONIZATION
B-Y PHASE 90°
BURST Up
SYNC Up
REF Up
SUBCARRIER PHASE As is

POWER ON

Test Oscilloscope Controls

Viewing As desired

Time Base A
Triggering Level CW, pushed in
Triggering
Mode Auto
Slope +
Coupling AC
Source INT
Time/Cm 1 μ s
Variable (Time/Cm) Calibrated

Time Base B
Triggering Level Near 0, pushed in
Triggering
Mode Trig
Slope —
Coupling DC
Source EXT
Time/Cm 10 μ s
Variable (Time/Cm) Calibrated

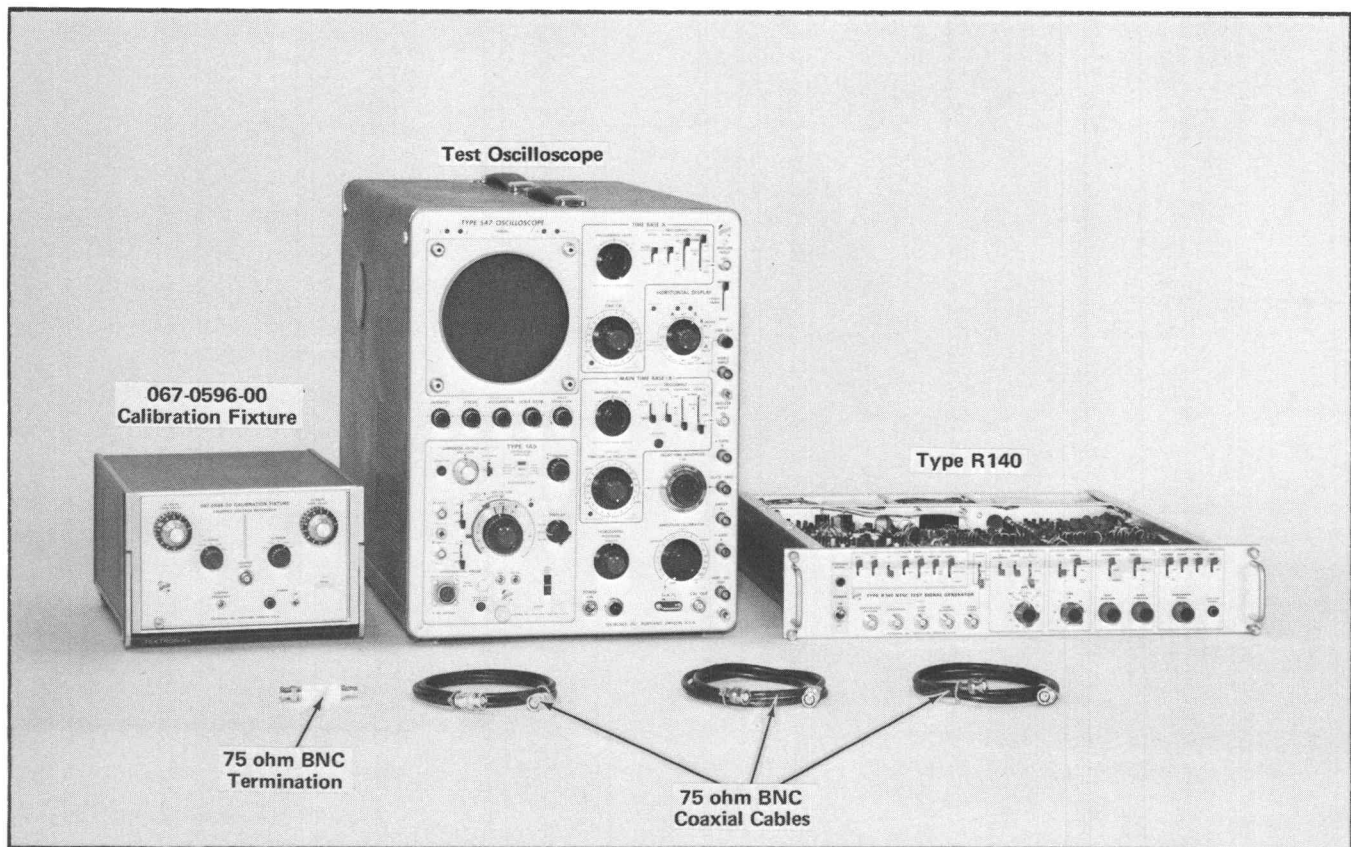


Fig. 5-21. Test equipment required for steps 18 through 31.

Horizontal Display	B
Sweep Magnifier	Off
Single Sweep	Normal

Delay-Time Multiplier	As is
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	DC
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

067-0596-00 Calibration Fixture Controls

V_1	
Range	-1.1 V
Volts	3-0-61

V_2	
Range	+1.1 V
Volts	3-0-61

18. Check/Adjust Chrominance Amplifier

a. Test equipment is shown in Fig. 5-21.

b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.

c. From the Type R140 rear-panel COMP BLANKING connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base B Trigger Input connector.

d. From the 067-0596-00 calibration fixture Chopped Output connector, connect a 75 ohm coaxial cable to the Type 1A5 B Input connector.

e. Set the test oscilloscope Time Base B Trigger Level control for a triggered display.

Performance Check/Calibration—Type 140/R140

f. Observing the test oscilloscope displays, rotate the 067-0596-00 calibration fixture V_2 Volts control until top of the bottom display just meets the bottom of the top display.

g. Set the Type 1A5 Volts/Cm switch to 10 mV.

h. Repeat part f.

i. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; must be between 2-9-99 and 3-1-23 (610 mV $\pm 1\%$).

j. Set the 067-0596-00 Calibration fixture V_2 Volts control for a dial setting of 3-0-61.

k. ADJUST—R482 (see Fig. 5-22) until the top of the bottom display just meets with the bottom of the top display.

l. Test equipment remains connected.

19. Check APL Subcarrier Modulation Amplitude

NOTE

If any of the following checks are not within the listed tolerance, repeat step 18.

a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to OFF.

c. CHECK—Test oscilloscope display; modulation should not be present on the display.

d. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to UNMOD.

e. Set the 067-0596-00 calibration fixture V_1 Range switch to 0 and the V_2 Volts control for a dial setting of 0-3-01 (30 mV).

f. Set the Type 1A5 Volts/Cm switch to 10 mV.

g. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the two displays just meet.

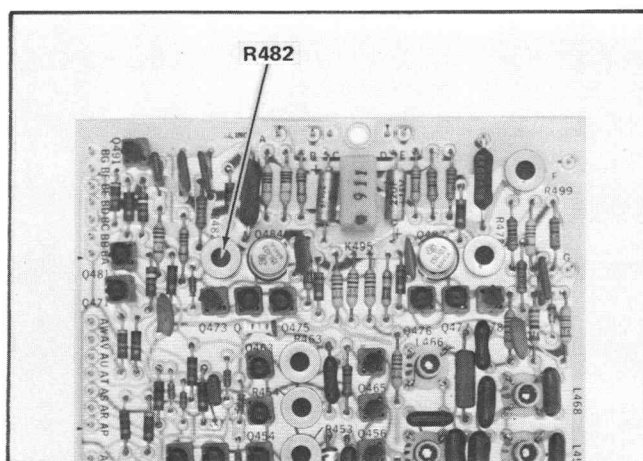


Fig. 5-22. Bar Drive and Video Out board adjustment locations.

h. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-2-86 and 0-3-16 (30 mV ± 1.5 mV).

i. Set the Type 1A5 B Input AC-GND-DC switch to GND.

j. CHECK—Test oscilloscope display; duration of modulation should be approximately 52.3 μ s (as measured from the 50% points between the blanking level and the most positive excursion of the modulation).

k. Set the Type 1A5 Volts/Cm switch to .2 V.

l. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to MOD.

m. CHECK—Test oscilloscope display; display should be similar to Fig. 5-23.

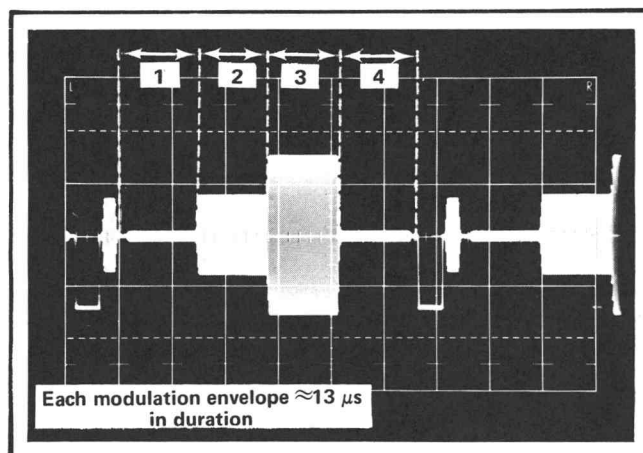


Fig. 5-23. Typical display showing the modulated subcarrier. Used to check amplitude and duration.

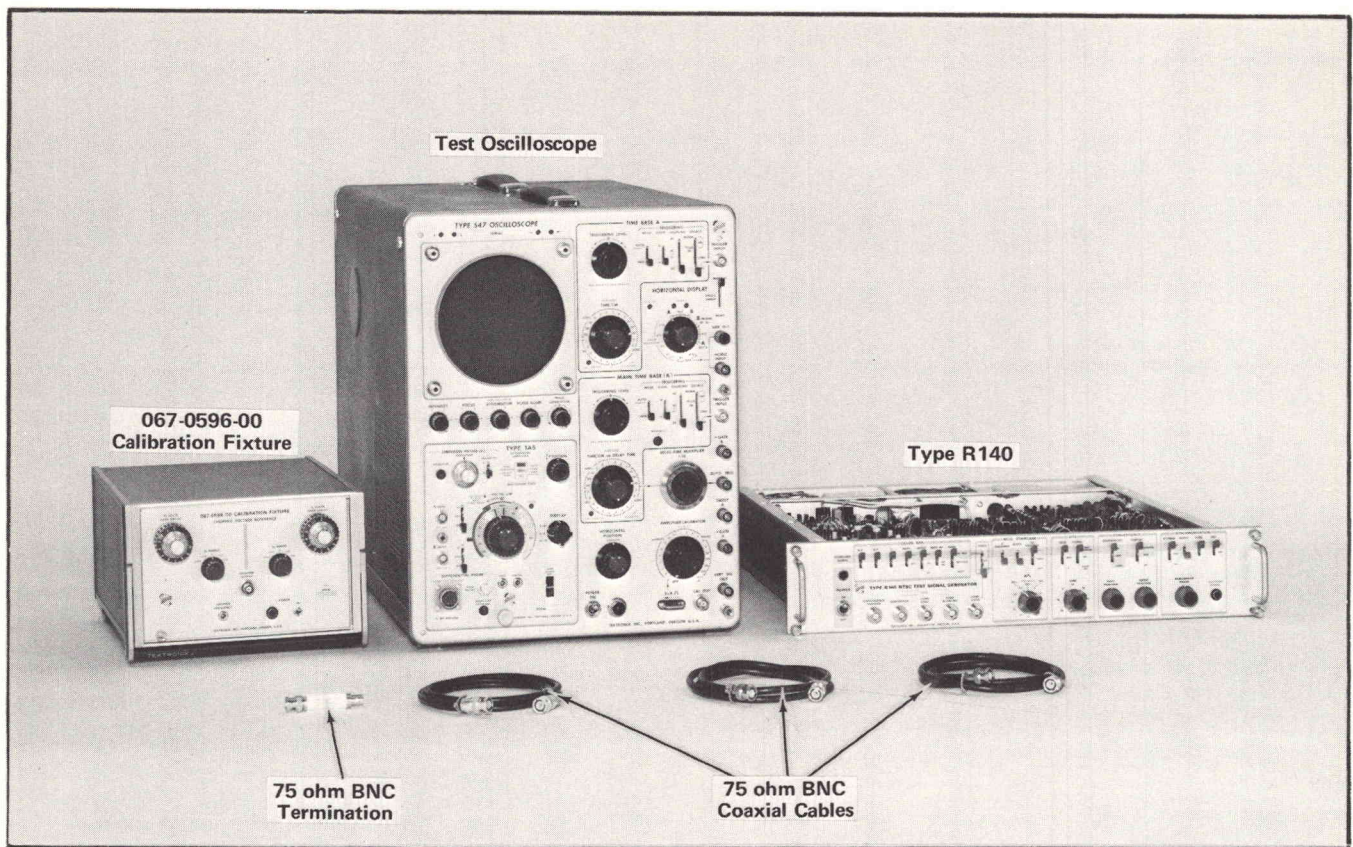


Fig. 5-6. Test equipment required for steps 7 through 11.

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	DC
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

067-0596-00 Calibration Fixture Controls

V ₁	
Range	0
Volts	0-0-0
V ₂	
Range	+1.1 V
Volts	2-0-0
Chopper Frequency	As is
Power	On

7. Check/Adjust Luminance Amplifier Gain

- a. Test equipment is shown in Fig. 5-6.
- b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.
- c. From the Type R140 rear-panel HORIZ DRIVE connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.
- d. From the 067-0596-00 calibration fixture Chopped Output connector, connect a 75 ohm coaxial cable to the Type 1A5 B Input connector.
- e. Rotate the test oscilloscope Time Base A Triggering Level control for a triggered display.

NOTE

The test oscilloscope displays will be separated by approximately 1 major division.

Performance Check/Calibration—Type 140/R140

f. Set the 067-0596-00 calibration fixture V_2 Volts control to 0-0-0 and note that the displays are superimposed.

g. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 7-1-75 (714.3 mV).

NOTE

For the remainder of the Performance Check/Calibration procedure, all dial settings of the 067-0596-00 calibration fixture Volts dial(s) will include an error factor. See the 067-0596-00 calibration fixture operation manual for details.

h. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the 100 IRE level line of the lower display and the blanking level of the upper display are aligned as shown in Fig. 5-7A.

i. Set the Type 1A5 Volts/Cm switch to 10 mV; repeat part h.

j. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 7-1-02 and 7-2-48 (714.3 mV, $\pm 1\%$).

k. Rotate the 067-0596-00 calibration fixture V_2 Volts control to a dial setting of 7-1-75.

l. ADJUST—Luminance Gain control, R499 (see Fig. 5-8) until the 100 IRE level line and the blanking level are aligned.

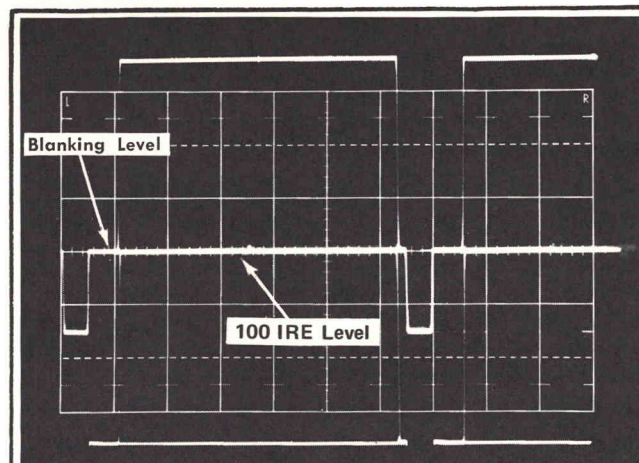
m. Test equipment remains connected.

8. Check/Adjust Sync Amplitude

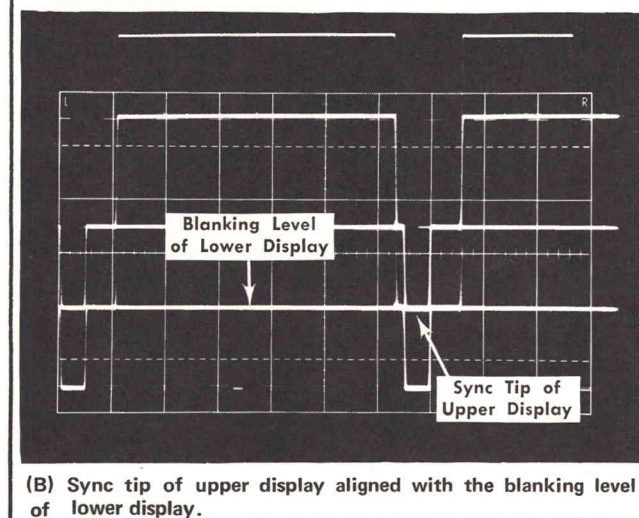
a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the 067-0596-00 calibration fixture V_2 Range switch to -1.1 V and rotate the V_2 Volts control to a dial setting of 2-8-85 (-285.7 mV).

c. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the sync tip of the upper display just aligns with the blanking level of the lower display; see Fig. 5-7B.



(A) 100 IRE level aligned with the blanking level.



(B) Sync tip of upper display aligned with the blanking level of lower display.

Fig. 5-7. Luminance and Sync Amplifiers properly adjusted.

d. Set the Type 1A5 Volts/Cm switch to 10 mV; repeat part c.

e. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 2-8-39 and 2-8-91 (285.7 mV, $\pm 1\%$).

f. Set the 067-0596-00 calibration fixture V_2 Volts control to a dial setting of 2-8-85.

g. ADJUST—Sync Amplifier control, R567, (see Fig. 5-9) until the sync tip just aligns with the blanking level.

h. Test equipment remains connected.

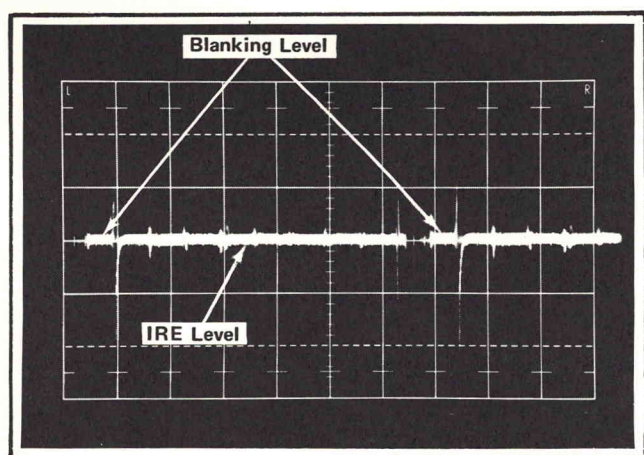


Fig. 5-10. Typical display with IRE level aligned with the blanking level.

g. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the blanking level is aligned with the 10 IRE level line as shown in Fig. 5-10.

h. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; must be between 0-7-02 and 0-7-30 (71.4 mV, $\pm 2\%$).

i. Set the 067-0596-00 calibration fixture V_2 Range switch to 0, V_1 Range switch to +1.1 V and V_1 Volts control to approximately 0-7-16.

j. Set the Type 1A5 Position control to approximately midrange.

k. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the IRE level line (as indicated by the IRE LEVEL switch setting) is aligned with the blanking level.

l. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 20.

m. Rotate the Type 1A5 Position control fully counter-clockwise.

n. Set the 067-0596-00 calibration fixture V_2 Range switch to -1.1 V.

o. Observing the test oscilloscope display, rotate the

067-0596-00 calibration fixture V_2 Volts control until the blanking level is aligned with the IRE level line.

p. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-7-02 and 0-7-30 (71.4 mV, $\pm 2\%$).

q. Set the 067-0596-00 calibration fixture V_2 Range switch to 0 and the V_1 Volts control to approximately 1-4-0.

r. Rotate the Type 1A5 Position control to approximately midrange.

s. Repeat part k.

t. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 30.

u. Repeat parts m, n, o, and p.

v. Using the procedure just described for checking the 10, 20, and 30 IRE LEVEL switch setting and Fig. 5-10, check all remaining settings of the Type R140 MOD STAIRCASE APL/IRE LEVEL switch listed in Table 5-1.

TABLE 5-1

Set APL/ IRE LEVEL switch to:	Type 1A5 Position control	067-0596-00 Calibration Fixture			Repeat part:
		V_1 Range	V_2 Range	V_1 Volts	
NC ²	Midrange	+1.1 V	0	2-1-65	k
40	CCW	NC	-1.1 V	NC	0 and p
NC	Midrange	NC	0	2-8-76	k
50	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	3-5-95	k
60	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	4-3-14	k
70	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	5-0-25	k
80	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	5-7-40	k
90	CCW	NC	-1.1 V	NC	o and p
NC	Midrange	NC	0	6-4-65	k
100	CCW	NC	-1.1 V	NC	o and p

²NC—No change from previous setting.

w. Test equipment remains connected.

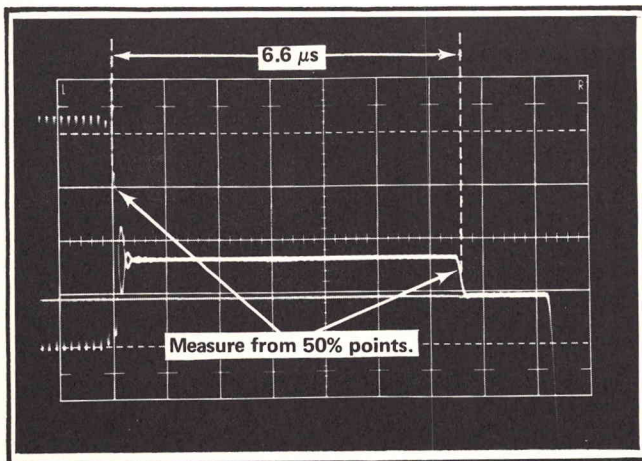


Fig. 5-11. Black bar width properly adjusted.

11. Check/Adjust Bar Width

①

a. Set the Type 1A5 Volts/Cm switch to .1 V, Display switch to A-Vc and the B Input AC-GND-DC switch to GND.

b. Set the Type R140 VIDEO switch up, and the SYNCHRONIZATION BURST switch up.

c. Set the test oscilloscope Horizontal Display Sweep Magnifier switch to X10 and rotate the Horizontal Position control to position the start of the black bar on a major graticule line as shown in Fig. 5-11.

d. CHECK—Test oscilloscope display, black bar width must be between 6.3 and 6.9 μ s.

e. ADJUST—Bar Width control, L217, (see Fig. 5-12) for a black bar width of 6.6 μ s.

f. Disconnect all test equipment.

Type R140 Controls

COLOR BAR

R-Y	Up
B-Y	Up
Y	Up
AMPL	75%
SETUP	10%
WHITE REF	Up
BARS	FULL FIELD

VIDEO Up

MOD STAIRCASE

0° SUBCARRIER	Up
STEPS	Up
90° SUBCARRIER	Off
APL/IRE LEVEL	50%

VITS

FIELD	BOTH
SIGNAL	MOD STAIRCASE
LINE	15

CONVERGENCE

CROSSHATCH	ON
DISPLAY	CROSSHATCH
VERT POSITION	Midrange
HORIZ POSITION	Midrange

SYNCHRONIZATION

R-Y PHASE	90°
BURST	Up
SYNC	Up
REF	Up
SUBCARRIER PHASE	As is

POWER

ON

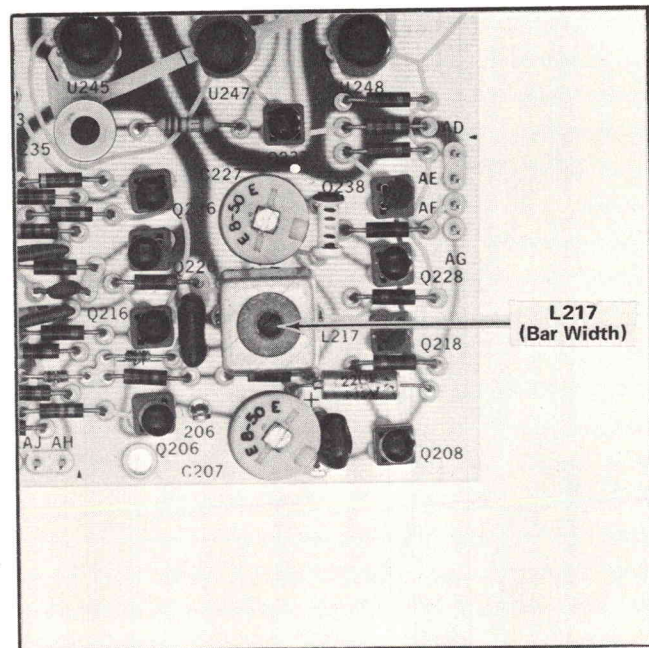


Fig. 5-12. Bar Timing board adjustment location.

Performance Check/Calibration—Type 140/R140

Test Oscilloscope Controls		Display	
Viewing	As desired	Position	A-Vc
		Step Atten Bal	Midrange
Time Base A		Comparison Voltage	As is
Triggering Level	Near 0, pushed in	Amplitude	0-0
Triggering Mode	Trig	Polarity	0
Slope	—		
Coupling	DC	Vectorscope Controls	
Source	Ext	Signal Selector	Ch A, FULL FIELD, A ϕ
Time/Cm	10 μ s	Channel A	
Variable (Time/Cm)	Calibrated	100%-75%-Max Gain	75%
Time Base B	Not used	Gain	As is
Horizontal Display	A	Phase	As is
Sweep Magnifier	Off	A Cal	Cal
Single Sweep	Normal	Channel B	Not used
Delay-Time Multiplier	Not used	ϕ Ref	ϕ Ref Burst
Horizontal Position	Midrange	Function Selector	Vector
Vernier (Horizontal Position)	Midrange	Intensity	As desired
Power	On	Luminance Gain	Cal
Amplitude Calibrator	Off	Scale Illum	As desired
		Calibrated Phase	0
		Power	On
		Left recessed front-panel controls	As is
		Right recessed front-panel controls	As is
Type 1A5 Controls			
A Input AC-GND-DC	AC		
B Input AC-GND-DC	GND		
Volts/Cm	5 mV		
Variable (Volts/Cm)	Cal		

NOTES

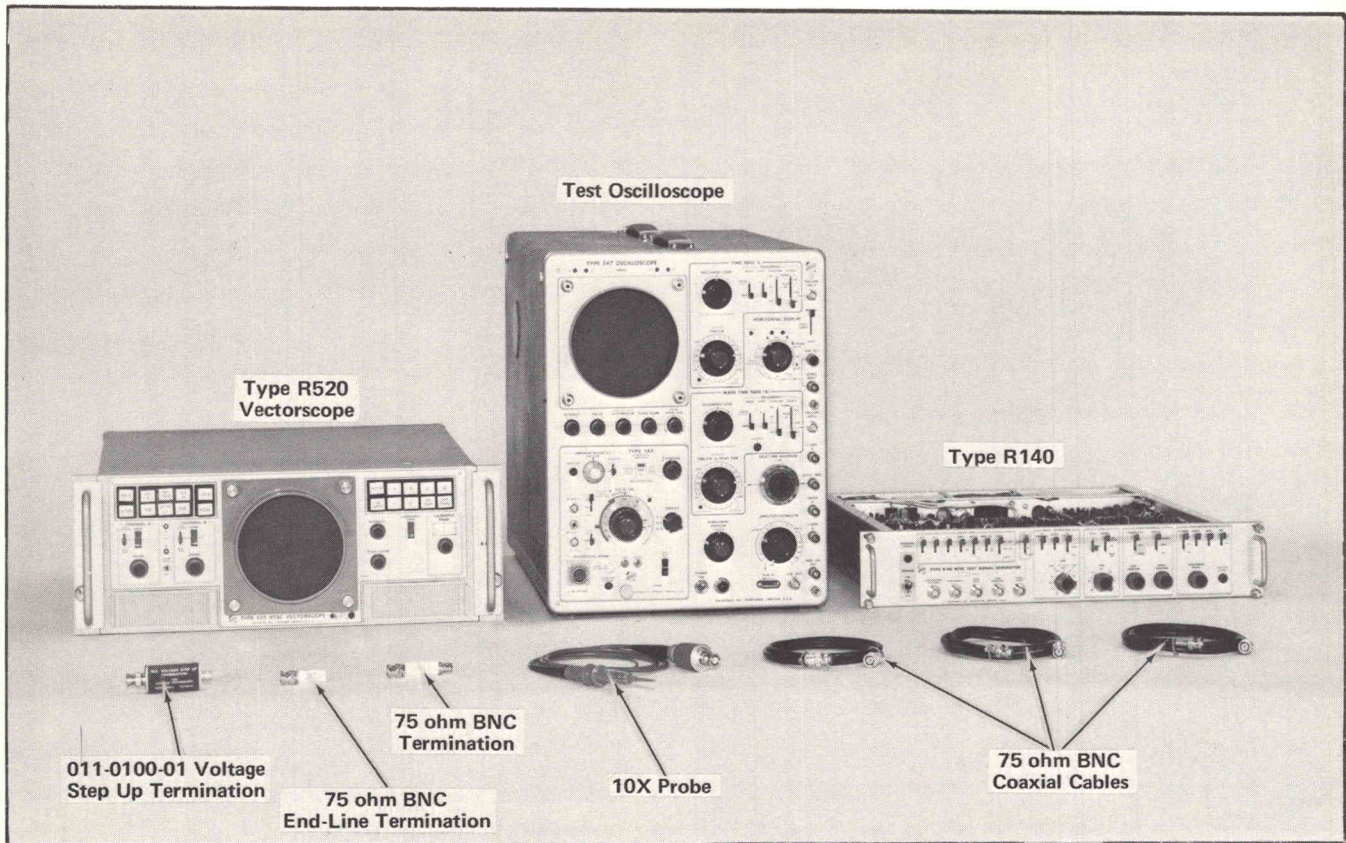


Fig. 5-13. Test equipment required for steps 12 through 17.

12. Adjust R-Y and B-Y Modulator Filters

- a. Test equipment is shown in Fig. 5-13.
- b. Connect a properly compensated 10X probe to the Type 1A5 A Input connector.
- c. From the Type R140 rear-panel COMP BLANKING connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.
- d. Connect the 10X probe tip to TP188 on the Modulator board (see Fig. 5-14).
- e. ADJUST— +(B-Y) Filter, L187, for the best square corner on the leading edges of the display as shown in Fig. 5-15A.
- f. Disconnect the 10X probe from TP188 and reconnect it to TP168.
- g. ADJUST— -(B-Y) Filter, L167, for the best square corner on the leading edges of the display as shown in Fig. 5-15B.
- h. Disconnect the 10X probe from TP168, set the Type 1A5 Volts/Cm switch to 10 mV, and then reconnect the probe to TP182.
- i. ADJUST— +(R-Y) Filter, L183, for the best square corner on the leading edges of the display as shown in Fig. 5-15C.
- j. Disconnect the 10X probe from TP182 and reconnect it to TP162.
- k. ADJUST— -(R-Y) Filter, L163, for the best square corner on the leading edges of the display as shown in Fig. 5-15D.
- l. Disconnect the 10X probe from TP162 and the Type 1A5.
- m. Test equipment remains connected.

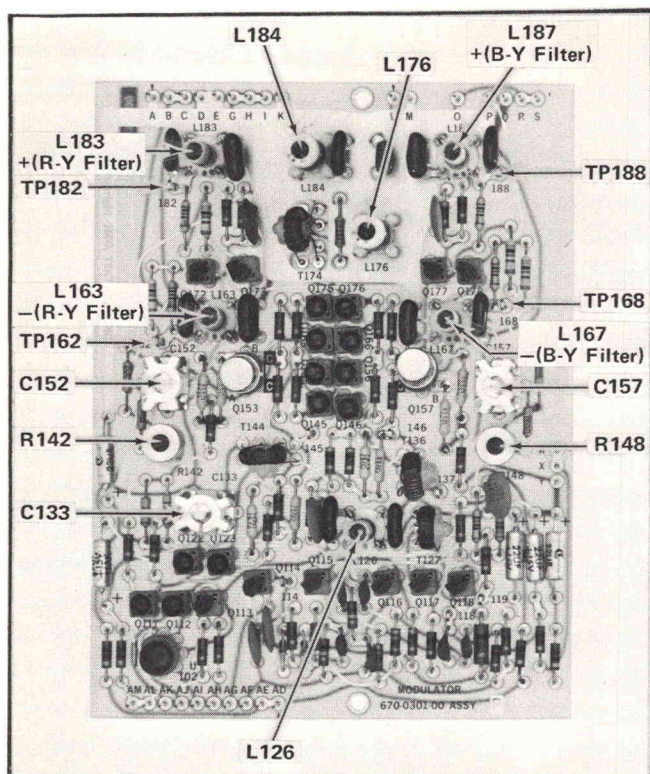


Fig. 5-14. Modulator board adjustment and test point locations.

13. Check/Adjust Carrier Balance



a. Set the Type 1A5 A Input AC-GND-DC switch to DC and the Volts/Cm switch to .2 V.

b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.

c. Observing the test oscilloscope display, rotate the Type 1A5 Position control to position the blanking level of the display to the center graticule line. Then, set the Volts/Cm switch to 2 mV.

d. Set the Type R140 COLOR BAR R-Y, B-Y and Y switches down, SETUP switch to 0%, and the SYNCHRONIZATION R-Y PHASE switch to ALT.

e. CHECK—Test oscilloscope display; amplitude of chrominance on the blanking level must be less than 2.5 mV peak to peak. It may be necessary to use the Type 1A5 Comparison Voltage Amplitude control with + Polarity to position the blanking level on the graticule. (Disregard switching transients.)

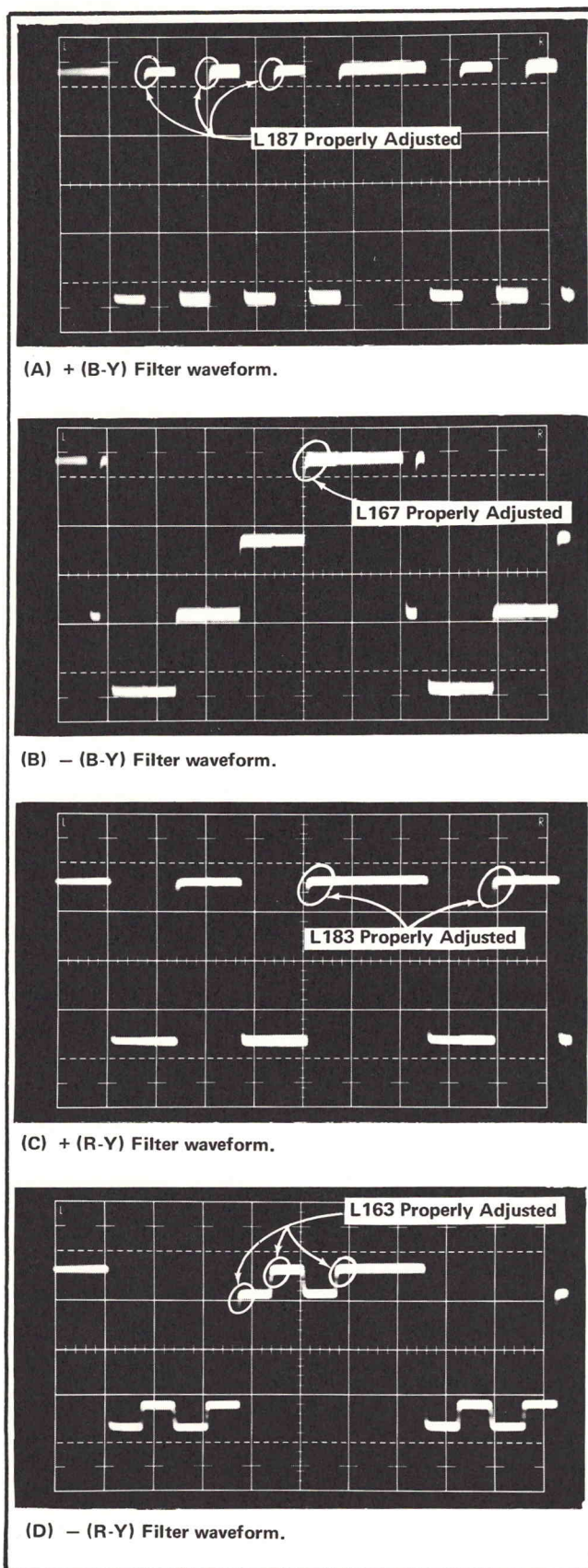


Fig. 5-15. Typical R-Y and B-Y Filter Waveforms.

NOTE

Proceed to part k for Performance Check.

f. Replace the 75 ohm termination from the Type 1A5 A Input connector with the 011-0100-01 Voltage Step Up Termination. If the Comparison Voltage Amplitude control was used in part e, set the Polarity switch to 0.

g. **ADJUST—C157, R148, C152, and R142, (see Fig. 5-14) for minimum peak-to-peak chrominance on the blanking level.**

h. Set the Type 1A5 Volts/Cm switch to 1 mV and repeat part g.

NOTE

C157, R148, C152, and R142 adjustments interact. Repeat the adjustments several times to obtain as absolute minimum.

i. Replace the 011-0100-01 Voltage Step Up Termination with the 75 ohm termination.

j. Repeat part e.

k. Set the Type 1A5 A Input AC-GND-DC switch to GND.

l. Test equipment remains connected.

14. Check/Adjust R-Y 180° Phase Switcher

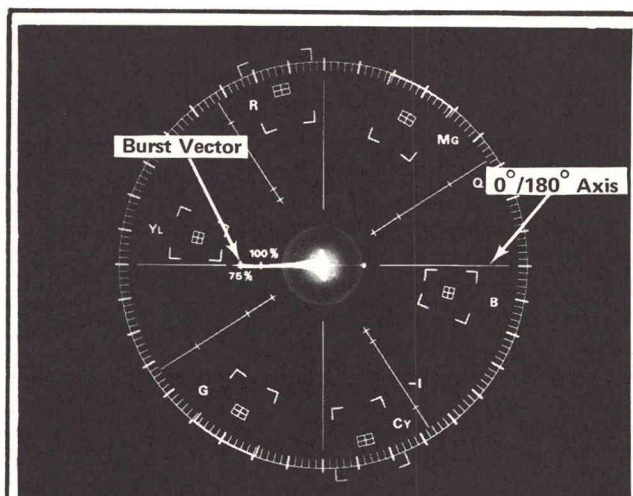
a. From the Type R140 rear-panel COMP VIDEO connector, connect a 75 ohm coaxial cable to the vectorscope CH A J1 connector.

b. Connect a 75 ohm end-line termination to the vector-scope CH A J2 connector.

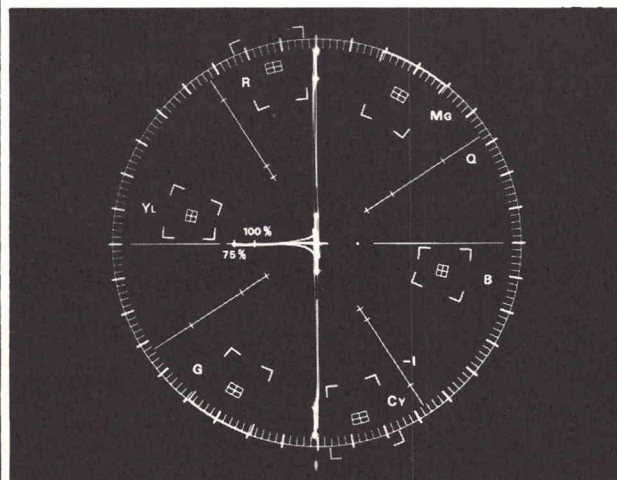
c. Observing the vectorscope display, rotate the Channel A Phase Control to align the burst vector with the 0°/180° axis as shown in Fig. 5-16A.

d. Set the Type R140 COLOR BAR R-Y switch up.

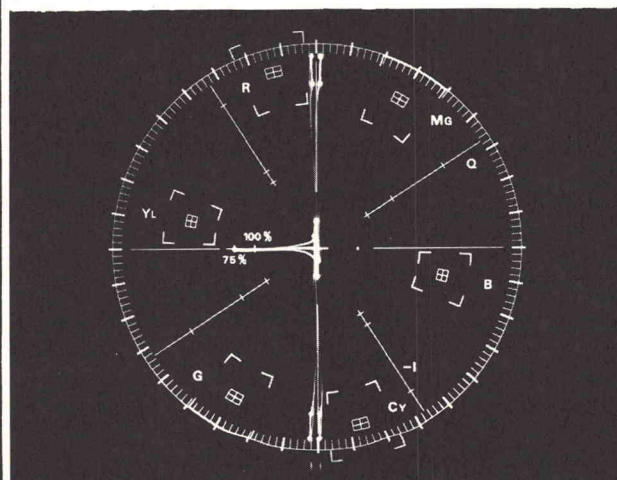
e. **CHECK—**Vectorscope display; dots must overlay within 0.5°; see Fig. 5-16B.



(A) Burst vector properly aligned with the 0°/180° axis of the vectorscope "Vector" graticule.



(B) R-Y 180° Phase Switcher properly adjusted.



(C) R-Y 180° Phase Switcher misadjusted.

Fig. 5-16. Typical Type 520 Vectorscope displays used to check and/or adjust the R-Y 180° Phase Switcher.

NOTE

Fig. 5-16C shows misadjustment of the R-Y 180° Phase Switcher. Use the Vectorscope Calibrated Phase dial to measure any error.

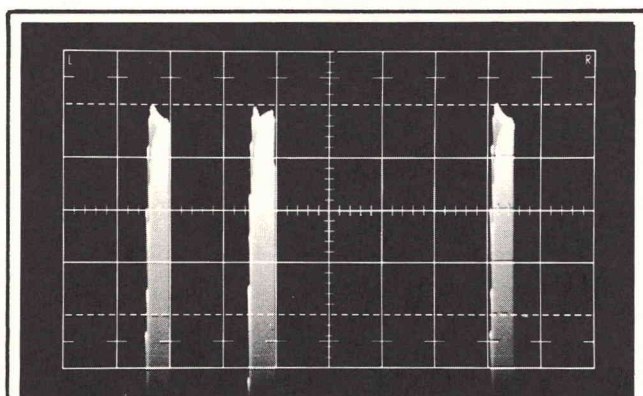
f. **ADJUST—C133** (see Fig. 5-14) until the requirement of part e is met.

g. Set the Type R140 COLOR BAR B-Y switch up.

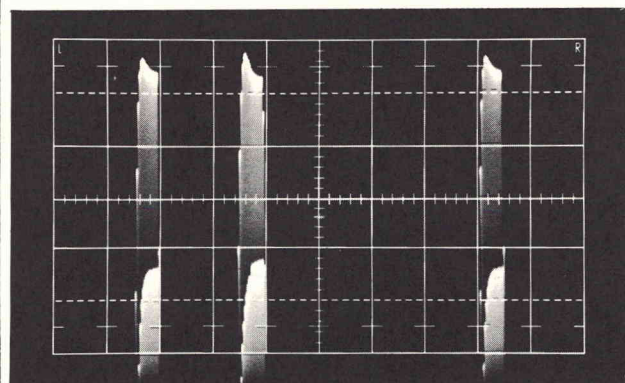
h. Test equipment remains connected.

15. Check/Adjust Modulator Quadrature Phasing

a. Replace the 75 ohm termination on the Type 1A5 A Input connector with the 011-0100-01 Voltage Step Up Termination. Then, set the Volts/Cm switch to 10 mV, A Input AC-GND-DC switch to DC, Position control to mid-range, Comparison Voltage Polarity switch +, and rotate the Comparison Voltage Amplitude control to position the positive peaks of the display as shown in Fig. 5-17A.



(A) Correct color bar phasing.



(B) Incorrect color bar phasing.

Fig. 5-17. Typical displays showing correct and incorrect adjustment of color bar phasing. (Using Voltage Step Up Termination.)

b. **CHECK**—Test oscilloscope display; displays must overlay within 10 mV. (Typically 8 mV.)

c. Set the Type 1A5 Comparison Voltage Amplitude control to —.

d. Repeat part b using the negative peaks of the display.

e. **ADJUST—L126** (See Fig. 5-14) for best color bar overlay; must be within 10 mV. (See Fig. 5-17B for improper display.)

f. Set the Type 1A5 Comparison Voltage Amplitude Polarity switch to +.

g. Repeat part e.

h. **INTERACTION**—If step 15 is performed out of sequence, step 13 must also be repeated before continuing.

i. Test equipment remains connected.

16. Check/Adjust Spurious Subcarrier

a. Set the Type 1A5 Volts/Cm switch to .2 V and the Comparison Voltage Polarity switch to 0. Then, replace the 011-0100-01 Voltage Step Up Termination with a 75 ohm termination.

b. Set the test oscilloscope Time Base A Time/Cm switch to 2 μ s and rotate the Horizontal Position Control to position the display horizontally on the test oscilloscope as shown in Fig. 5-18A.

c. Set the Type 1A5 Volts/Cm switch to 10 mV.

d. **CHECK**—Test oscilloscope display; 3.58 MHz aberration between burst and the first color bar must be less than or equal to 32 mV peak to peak; see Fig. 5-18B.

NOTE

Proceed to part k for Performance Check.

e. Set the Type R140 COLOR BAR B-Y switch down.

f. **ADJUST—C422** (see Fig. 5-19) and Readjust L163 (see Fig. 5-14) for minimum 3.58 MHz aberration between burst and the first color bar.

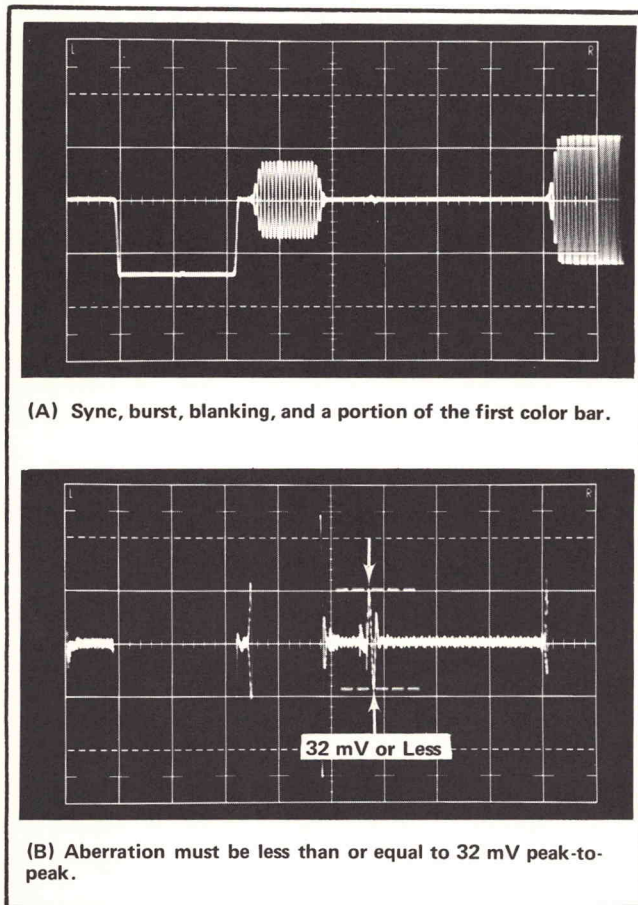


Fig. 5-18. Typical displays used to check and/or adjust spurious output.

g. Set the Type R140 COLOR BAR R-Y switch down and the B-Y switch up.

h. ADJUST—C427 (see Fig. 5-19) and Readjust L167 (see Fig. 5-14) for minimum 3.58 MHz aberration between burst and the first color bar.

i. Set the Type R140 COLOR BAR R-Y switch up.

j. Repeat part d.

k. Test equipment remains connected.

17. Adjust Modulator Output Filter

a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the test oscilloscope Time Base A Time/Cm switch to 10 μ s.

c. Observing the test oscilloscope display, rotate the Horizontal position controls to position the green-magenta transition to the center (horizontal) graticule lines as shown in Fig. 5-20A.

d. Set the test oscilloscope Sweep Magnifier switch to X10.

e. CAUTION—Pull transistor Q683, see Fig. 5-5 on the Type R140 Line Timing board.

f. ADJUST—L176 and L184 (see Fig. 5-14) for (1) best green-magenta transition; (2) best square corner on the magenta chrominance; (3) best overlay of the displays. (See Fig. 5-20B.)

g. Set the test oscilloscope Sweep Magnifier switch to Off.

h. Set the Type 1A5 Volts/Cm switch to 1 mV and rotate the Position control to position the blanking level of the display to the center graticule line; see Fig. 5-20C.

i. READJUST—L176 and L184 for less than 2.5 mV (peak to peak) of chrominance on the blanking level.

j. Set the Type 1A5 Volts/Cm switch to .2 V and rotate the Position control to approximately midrange.

k. Repeat (in listed order) parts d, f, g, h, i, and j several times to remove interaction of adjustments.

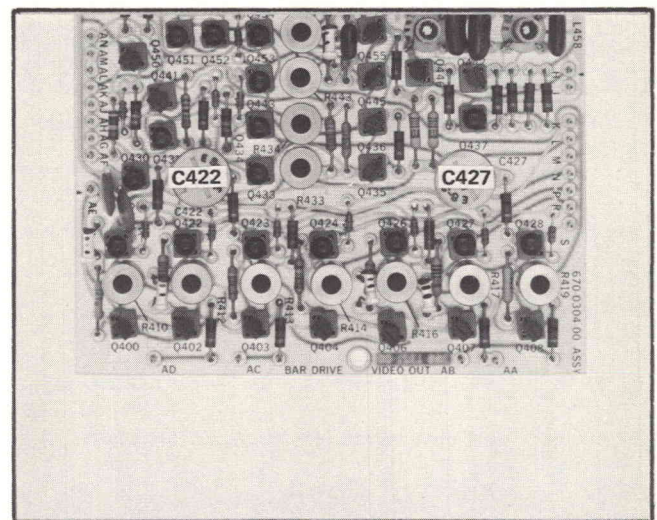


Fig. 5-19. Bar Drive and Video Out board adjustment locations.

Performance Check/Calibration—Type 140/R140

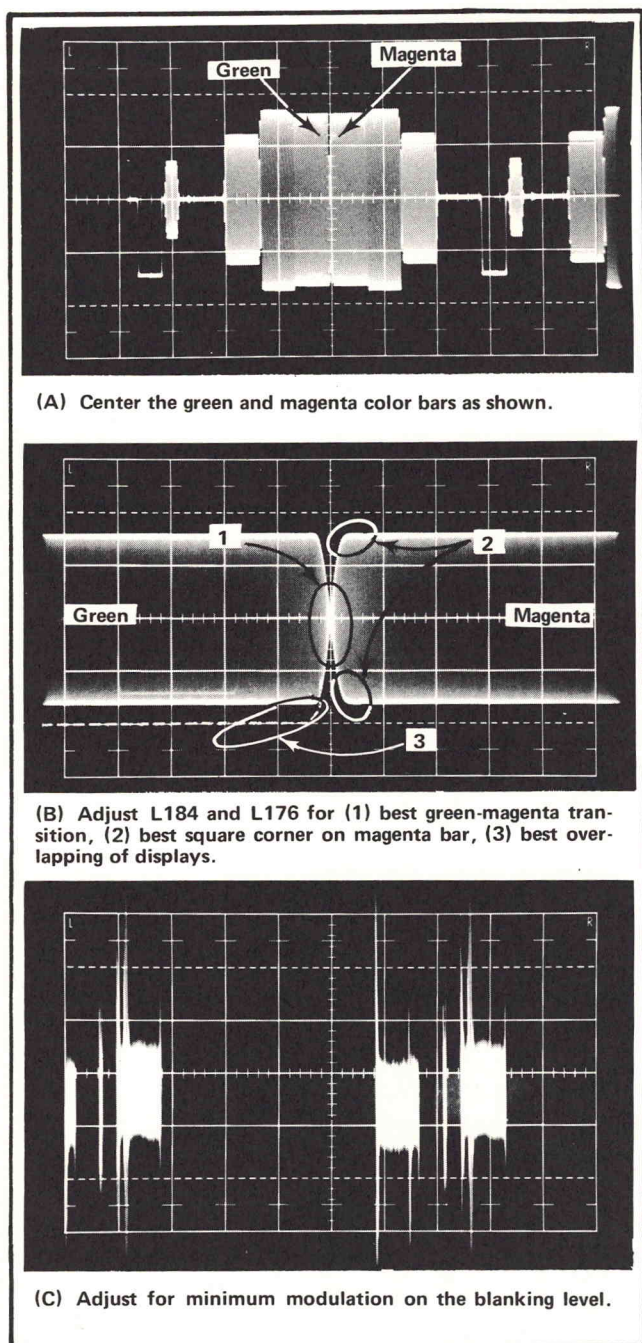


Fig. 5-20. Typical displays to adjust the Modulator Output Filter.

l. Replace Q683 removed in part e.

m. INTERACTION—Step 18 must be completed.

n. Disconnect all test equipment and connections.

Type R140 Controls

COLOR BAR
R-Y

Up

B-Y Up
Y Down
AMPL 75%
SETUP 10%
WHITE REF Up
BARS FULL FIELD

VIDEO Down

MOD STAIRCASE
0° SUBCARRIER Down
STEPS Down
90° SUBCARRIER MOD
APL/IRE LEVEL 50%

VITS
FIELD BOTH
SIGNAL MOD STAIRCASE
LINE 15

CONVERGENCE
CROSSHATCH ON
DISPLAY CROSSHATCH
VERT POSITION Midrange
HORIZ POSITION Midrange

SYNCHRONIZATION
B-Y PHASE 90°
BURST Up
SYNC Up
REF Up
SUBCARRIER PHASE As is

POWER ON

Test Oscilloscope Controls

Viewing As desired

Time Base A
Triggering Level CW, pushed in
Triggering
Mode Auto
Slope +
Coupling AC
Source INT
Time/Cm 1 μ s
Variable (Time/Cm) Calibrated

Time Base B
Triggering Level Near 0, pushed in
Triggering
Mode Trig
Slope —
Coupling DC
Source EXT
Time/Cm 10 μ s
Variable (Time/Cm) Calibrated

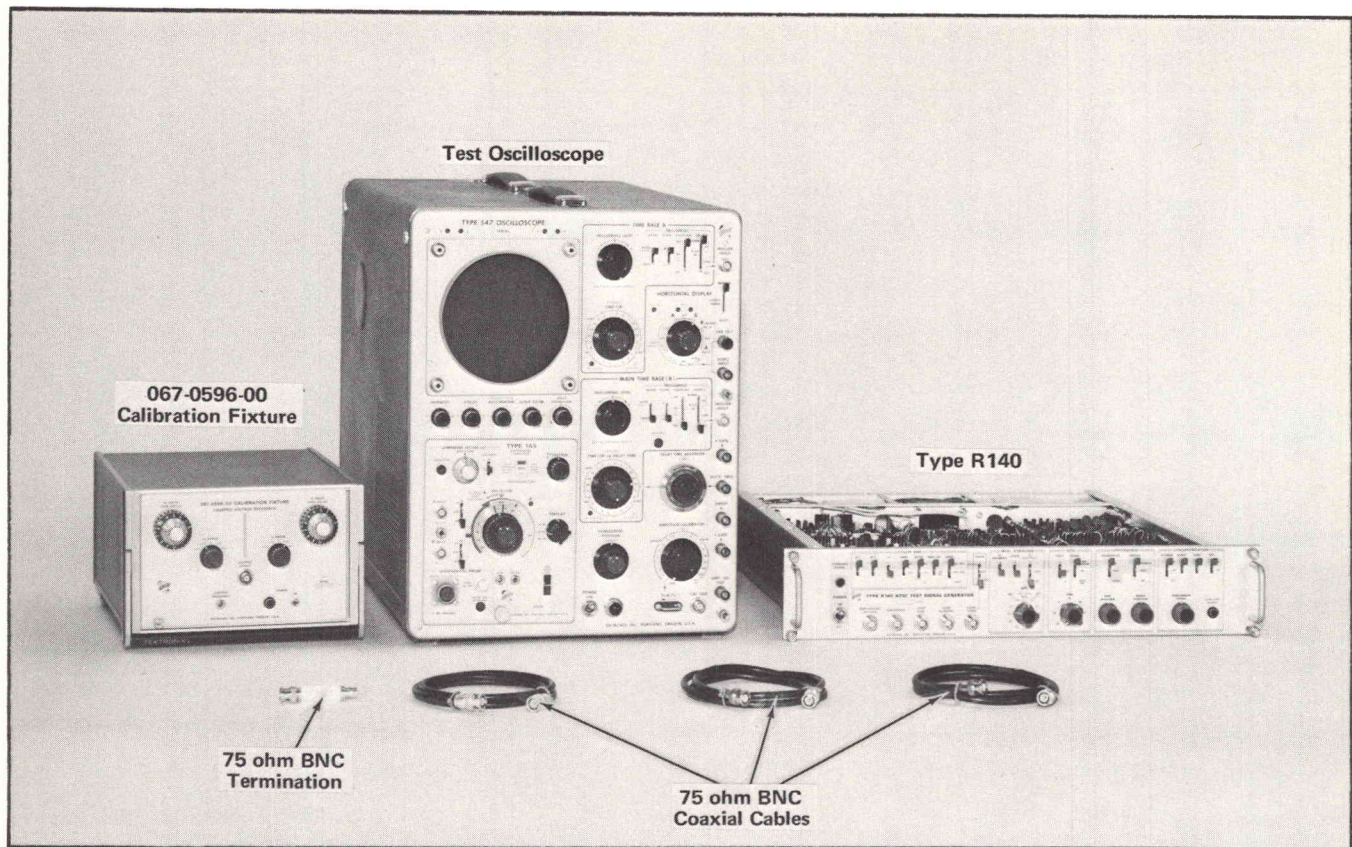


Fig. 5-21. Test equipment required for steps 18 through 31.

Horizontal Display	B
Sweep Magnifier	Off
Single Sweep	Normal

Delay-Time Multiplier	As is
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	DC
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

067-0596-00 Calibration Fixture Controls

V₁	
Range	-1.1 V
Volts	3-0-61

V₂	
Range	+1.1 V
Volts	3-0-61

18. Check/Adjust Chrominance Amplifier

a. Test equipment is shown in Fig. 5-21.

b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.

c. From the Type R140 rear-panel COMP BLANKING connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base B Trigger Input connector.

d. From the 067-0596-00 calibration fixture Chopped Output connector, connect a 75 ohm coaxial cable to the Type 1A5 B Input connector.

e. Set the test oscilloscope Time Base B Trigger Level control for a triggered display.

Performance Check/Calibration—Type 140/R140

f. Observing the test oscilloscope displays, rotate the 067-0596-00 calibration fixture V_2 Volts control until top of the bottom display just meets the bottom of the top display.

g. Set the Type 1A5 Volts/Cm switch to 10 mV.

h. Repeat part f.

i. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; must be between 2-9-99 and 3-1-23 (610 mV $\pm 1\%$).

j. Set the 067-0596-00 Calibration fixture V_2 Volts control for a dial setting of 3-0-61.

k. **ADJUST—R482** (see Fig. 5-22) until the top of the bottom display just meets with the bottom of the top display.

l. Test equipment remains connected.

19. Check APL Subcarrier Modulation Amplitude

NOTE

If any of the following checks are not within the listed tolerance, repeat step 18.

a. Set the Type 1A5 Volts/Cm switch to .2 V.

b. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to OFF.

c. CHECK—Test oscilloscope display; modulation should not be present on the display.

d. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to UNMOD.

e. Set the 067-0596-00 calibration fixture V_1 Range switch to 0 and the V_2 Volts control for a dial setting of 0-3-01 (30 mV).

f. Set the Type 1A5 Volts/Cm switch to 10 mV.

g. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the two displays just meet.

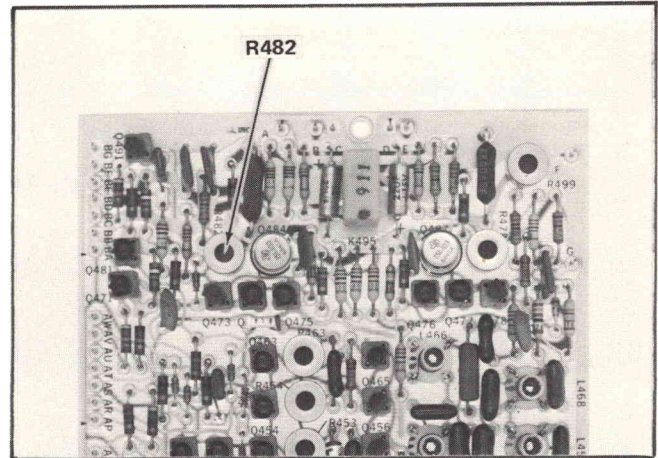


Fig. 5-22. Bar Drive and Video Out board adjustment locations.

h. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-2-86 and 0-3-16 (30 mV ± 1.5 mV).

i. Set the Type 1A5 B Input AC-GND-DC switch to GND.

j. CHECK—Test oscilloscope display; duration of modulation should be approximately 52.3 μ s (as measured from the 50% points between the blanking level and the most positive excursion of the modulation).

k. Set the Type 1A5 Volts/Cm switch to .2 V.

l. Set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to MOD.

m. CHECK—Test oscilloscope display; display should be similar to Fig. 5-23.

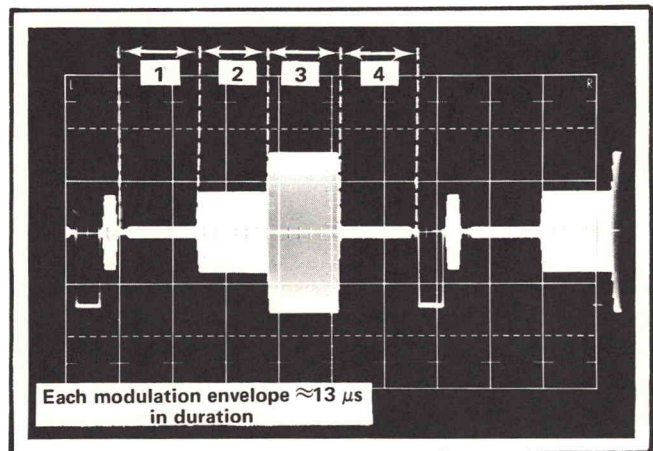


Fig. 5-23. Typical display showing the modulated subcarrier. Used to check amplitude and duration.

n. Set the 067-0596-00 calibration fixture V_1 Range switch to -1.1 V and the V_1 and V_2 Volts controls for dial settings of 0-1-50 each (30 mV).

o. Set the Type 1A5 Volts/Cm switch to 10 mV and the B Input AC-GND-DC switch to DC.

p. Observing the test oscilloscope display of the first or fourth modulation envelope, rotate the 067-0596-00 V_2 Volts control until the two displays just meet.

q. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-1-35 and 0-1-65 (30 mV ± 1.5 mV).

r. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts control for dial settings of 1-5-30 each (305 mV).

s. Repeat part p using the second modulation envelope.

t. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 1-4-38 and 1-6-22 (305 mV $\pm 3\%$).

u. Set the 067-0596-00 V_1 and V_2 Volts controls for dial setting of 3-0-61 each (610 mV).

v. Repeat part p using the third modulation envelope.

w. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 2-8-77 and 3-2-77 (610 mV, $\pm 3\%$).

x. Set the Type 1A5 Volts/Cm switch to .2 V, Display switch to A-Vc and the B Input AC-GND-DC switch to GND.

y. Set the test oscilloscope Sweep Magnifier switch to X5.

z. CHECK—Test oscilloscope display; duration of each modulation envelope should be approximately 13 μ s (as measured from the 50% points of each envelope).

aa. Test equipment remains connected.

20. Check Chrominance Amplitudes

a. Set the Type R140 COLOR BAR Y switch up and the VIDEO switch up.

b. Set the test oscilloscope Horizontal Display switch to B Intens By 'A' and the Sweep Magnifier switch to Off.

c. Set the test oscilloscope Delay-Time Multiplier control so that white is intensified as shown in Fig. 5-24A.

d. Set the test oscilloscope Horizontal Display switch to A Dly'd.

e. Set the Type 1A5 Volts/Cm switch to 1 mV, Comparison Voltage Polarity switch to +, and rotate the Comparison Voltage Amplitude control to position the intensified white portion of the display on the test oscilloscope graticule.

f. CHECK—Test oscilloscope display; peak-to-peak chrominance on white must be 2.5 mV peak to peak or less (see Fig. 5-24B).

NOTE

If part f is not within the listed tolerance, or if any of the following checks are not within the stated tolerance, proceed to Step 21 before continuing with step 20.

g. Set the test oscilloscope Horizontal Display switch to B Intens by 'A', and the Time Base A Time/Cm switch to .5 μ s.

h. Set the Type R140 Color Bar Y switch down.

i. Set the Type 1A5 Volts/Cm switch to .2 V, Comparison Voltage Polarity switch to 0, and rotate the Position control to center the display on the test oscilloscope.

j. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control until the red color bar is intensified.

k. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for a dial setting of 3-0-56 each (609 mV).

l. Set the test oscilloscope Horizontal Display switch to A Dly'd.

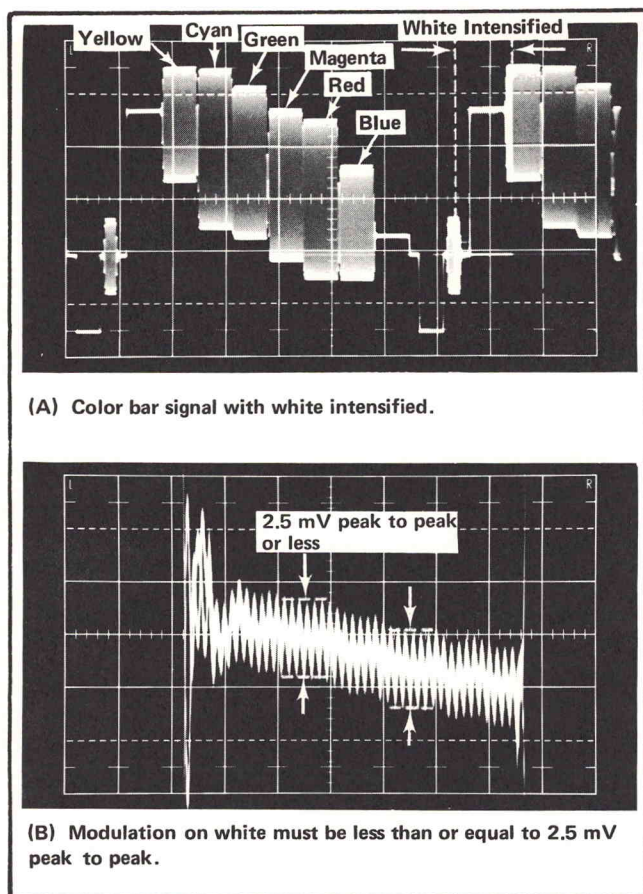


Fig. 5-24. Typical displays showing location of color signal components and white modulation.

m. Set the Type 1A5 Volts/Cm switch to 10 mV, Display switch to A-B, B Input AC-GND-DC switch to DC and rotate the Position control to position the display on the test oscilloscope as shown in Fig. 5-24B.

n. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the top of the bottom display just meets the bottom of the top display.

o. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 2-8-73 and 3-2-39 (609 mV, $\pm 3\%$).

p. Using the 067-0596-00 calibration fixture V_2 Volts control dial setting obtained in part o, compute and record the percentage error, if any, above or below the standard dial setting for the red color bar.

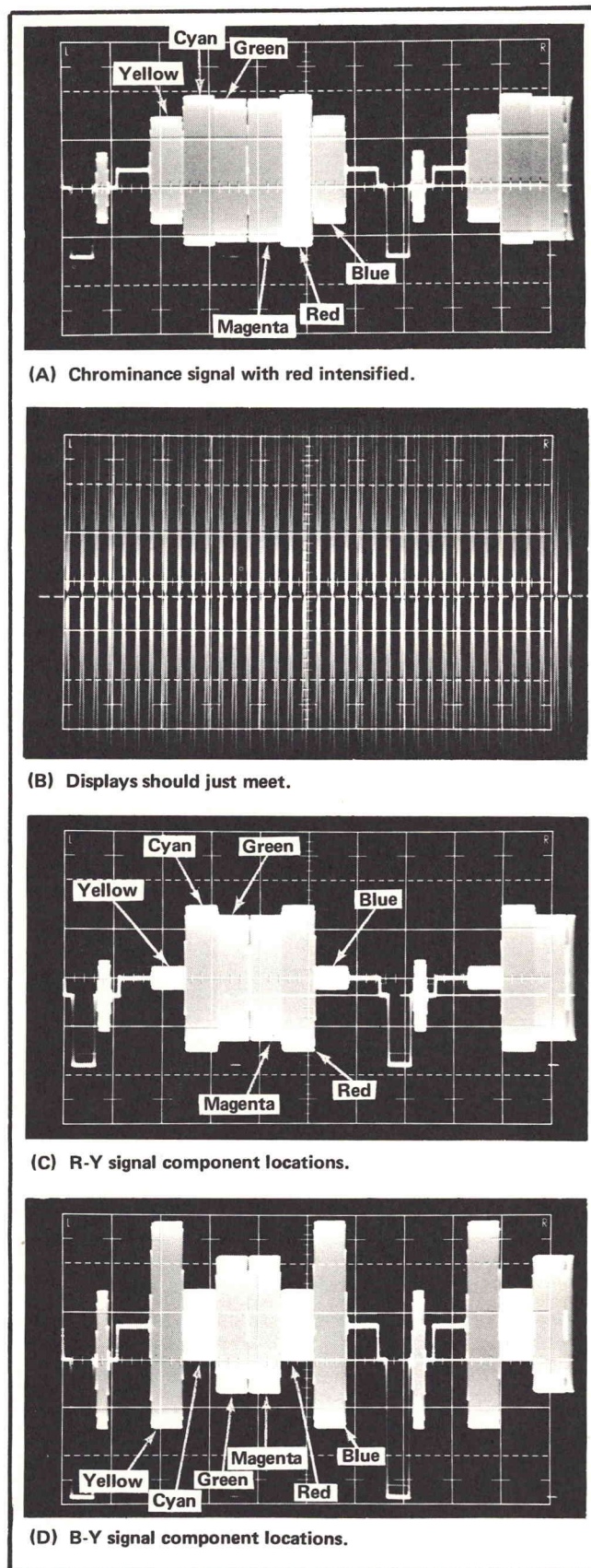


Fig. 5-25. Typical displays of the Chrominance, R-Y and B-Y signals.

NOTE

The percentage error computed in this part will be used to determine the error, if any, of the remaining chrominance amplitudes. For example, assume the V_2 Volts control dial setting obtained in part o was 2-8-73 (3% low) or 3-2-39 (3% high).

Add: V_1 and V_2 dial readings obtained in part o
 $305.6 + 287.3 = 592.9$ or
 $305.6 + 323.9 = 629.5$.

Add: V_1 and V_2 Volts control dial settings for the standard value of the red color bar
 $305.6 + 305.6 = 611.2$.

Subtract: Total dial settings obtained in part o from the total dial readings for the red color bar

$$611.2 - 592.9 \cong 18.3 \text{ low or}$$

$$611.2 - 629.7 \cong 18.3 \text{ high.}$$

% of error:

$$\frac{(18.3)(100)}{611.2} \cong 3\% \text{ low or high.}$$

q. Set the test oscilloscope Horizontal Display switch to B Intens By 'A'.

r. Set the Type 1A5 B Input AC-GND-DC switch to GND, Volts/Cm switch to .2 V and rotate the Position control to center the display on the test oscilloscope.

s. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control until the blue color bar is intensified.

t. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts control for a dial setting of 2-1-73 each (433 mV).

u. Repeat parts l, m, and n.

v. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting for the blue color bar must be within 1% of the error recorded for the red color bar in part p, but in no case must the total error for the blue color bar be greater than 3% above or below the standard dial setting.

NOTE

Referring back to the example given following part p, the percentage error was found to be either 3% low or 3% high. With this error, the dial reading obtained in part v would have to be between 2% and 3% below, or between 2% and 3% above, the standard value of the blue color bar. In other words the V_2 Volts control dial setting must be between 2-0-85 and 2-1-42 (2% to 3% below), or between 2-2-60 and 2-3-03 (2% to 3% above).

w. Using the procedure just described for checking the amplitude of the blue color bar, Fig. 5-25A, B, C and D, check each remaining chrominance amplitude listed in Table 5-2.

TABLE 5-2

Color (See Tolerance)	067-0596-00 Calibration Fixture			Tolerance
	V_1 Volts	V_2 Volts	Amplitude P-P	
Magenta	2-8-72	2-8-72	572.4 mV	Absolute amplitude of all Subcarrier frequency components (Chrominance R-Y, and B-Y are within 3%.
Green	2-8-72	2-8-72	572.4 mV	
Cyan	3-0-56	3-0-56	609.0 mV	
Yellow	2-1-72	2-1-72	433.0 mV	
Blue ³	0-4-66	0-4-66	93.3 mV	
Red ³	2-9-70	2-9-70	592.1 mV	
Magenta ³	2-5-54	2-5-54	499.1 mV	
Green ³	2-5-54	2-5-54	499.1 mV	
Cyan ³	2-9-70	2-9-70	592.1 mV	
Yellow ³	0-4-66	0-4-66	93.0 mV	
Blue ⁴	2-1-21	2-1-21	422.9 mV	Relative amplitudes of all Subcarrier frequency components are within 1% of the red chrominance bar.
Red ⁴	0-7-15	0-7-15	142.6 mV	
Magenta ⁴	1-4-65	1-4-65	280.4 mV	
Green ⁴	1-4-65	1-4-65	280.4 mV	
Cyan ⁴	0-7-15	0-7-15	142.6 mV	
Yellow ⁴	2-1-21	2-1-21	422.9 mV	

³ Set the Type R140 COLOR BAR B-Y switch down (R-Y).

⁴ Set the Type R140 COLOR BAR B-Y switch up and the R-Y switch down (B-Y); set the Type 1A5 Volts/Cm switch to .1 V.

TABLE 5-3

Color (see Tolerance)	067-0596-00 Calibration Fixture			Tolerance
	V ₁ Volts	V ₂ Volts	Amplitude P-P	
Red	4-5-33	4-5-33	902.3 mV	Absolute amplitude of all Subcarrier frequency components (Chrominance, R-Y, and B-Y) are within 3%.
Blue	3-2-21	3-2-21	641.6 mV	
Magenta	4-2-59	4-2-59	848.0 mV	
Green	4-2-59	4-2-59	848.0 mV	
Cyan	4-5-33	4-5-33	902.3 mV	
Yellow	3-2-21	3-2-21	641.6 mV	
Blue ⁵	0-6-91	0-6-91	137.8 mV	
Red ⁵	4-4-07	4-4-07	877.2 mV	
Magenta ⁵	3-7-13	3-7-13	739.3 mV	
Green ⁵	3-7-13	3-7-13	739.3 mV	
Cyan ⁵	4-4-07	4-4-07	877.2 mV	Relative amplitudes of all Subcarrier frequency components are within 1% of the red chrominance bar.
Yellow ⁵	0-6-91	0-6-91	137.8 mV	
Blue ⁶	3-1-45	3-1-45	626.6 mV	
Red ⁶	1-0-58	1-0-58	211.2 mV	
Magenta ⁶	2-0-83	2-0-83	415.4 mV	
Green ⁶	2-0-83	2-0-83	415.4 mV	
Cyan ⁶	1-0-58	1-0-58	211.2 mV	
Yellow ⁶	3-1-45	3-1-45	626.6 mV	

⁵ Set the Type R140 COLOR BAR B-Y switch down (R-Y).

⁶ Set the Type R140 COLOR BAR B-Y switch up and the R-Y switch down (B-Y); set the Type 1A5 Volts/Cm switch to .1 V.

x. Set the Type R140 COLOR BAR R-Y and B-Y switches up, the AMPL switch to 100%, and the SETUP switch to 0%.

y. Repeat part h through v for all components listed in Table 5-3.

NOTE

All values are different than those shown in Table 5-2, but procedure is identical.

z. Test equipment remains connected.

21. Adjust Chrominance Amplitudes



a. Set all test equipment controls as given following Fig. 5-21 except as follows:

Type R140

COLOR BAR	B-Y down
VIDEO	Up
MOD STAIRCASE	All up

Test Oscilloscope

Time Base A	Time/Cm to .5 μ s
Horizontal Display	B Intens By 'A'

067-0596-00 Calibration Fixture

V₁ and V₂ Volts 0-6-41

b. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control to intensify the blue color bar. Then, set the Horizontal Display switch to A Dly'd.

c. Set the Type 1A5 Volts/Cm switch to 10 mV.

d. ADJUST—R410 (see Fig. 5-26), until the two displays just meet.

e. Set the Type 1A5 Volts/Cm switch to .2 V and the test oscilloscope Horizontal Display switch to B Intens By 'A'.

f. Set the 067-0596-00 calibration fixture V₁ and V₂ Volts controls for a dial setting of 3-7-14 each (739.3 mV).

g. Repeat parts b and c using the green color bar.

h. ADJUST—R412 until the two displays just meet.

i. Repeat part e.

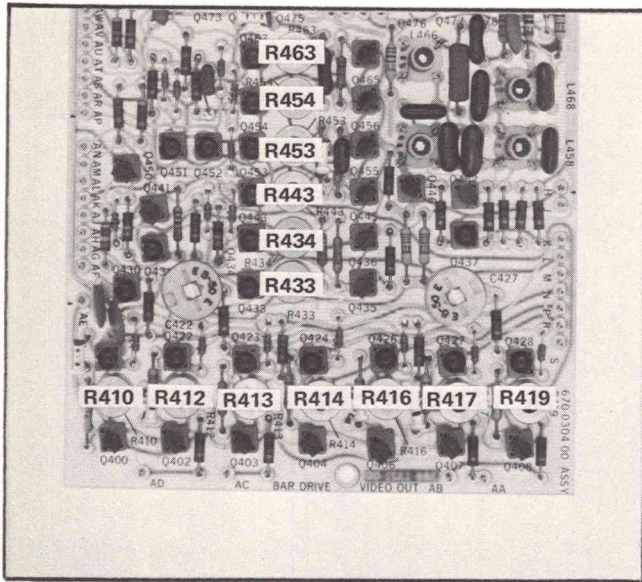


Fig. 5-26. Bar Drive and Video Out board adjustment locations.

j. Rotate the test oscilloscope Delay-Time Multiplier control to intensify the blanking level just prior to the yellow color bar.

k. Set the Type 1A5 Display switch to A-Vc, Volts/Cm switch to 2 mV, and the test oscilloscope Horizontal Display switch to A Dly'd.

l. ADJUST—R413 for minimum modulation on the blanking level.

m. Repeat part e.

n. Set the Type R140 COLOR BAR B-Y switch up and the R-Y switch down.

o. Set the Type 1A5 Display switch to A-B.

p. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls to dial settings of 1-0-86 each (211.2 mV).

q. Repeat parts b and c using the red color bar.

r. ADJUST—R416 until the two displays just meet.

s. Repeat part e.

t. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial setting of 2-0-83 each (415.4 mV).

u. Repeat parts b and c using the green color bar.

v. ADJUST—R417 until the two displays just meet.

w. Repeat (in listed order) parts e, j, and k.

x. ADJUST—R419 for minimum modulation on the blanking level.

y. Repeat Step 20 before continuing.

z. Test equipment remains connected.

22. Check/Adjust Burst Amplitude. 1

a. Set the test equipment controls as given following Fig. 5-21 except as follows:

Type R140

COLOR BAR	AMPL—100%, SETUP—0%
VIDEO	Up
MOD STAIRCASE	All up

Test Oscilloscope

Horizontal Display	B Intens By 'A'
--------------------	-----------------

067-0596-00 Calibration Fixture

V_1 and V_2 Volts	1-4-33
-----------------------	--------

b. Rotate the test oscilloscope Delay-Time Multiplier control to intensify burst.

c. Set the Type 1A5 Volts/Cm switch to 10 mV and set the test oscilloscope Horizontal Display switch to A Dly'd.

d. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the two displays just meet.

e. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 1-3-47 and 1-5-19 (285.7 mV, $\pm 3\%$).

Performance Check/Calibration—Type 140/R140

f. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 1-4-33.

g. **ADJUST—R414** (see Fig. 5-26) until the two displays just meet.

h. Test equipment remains connected.

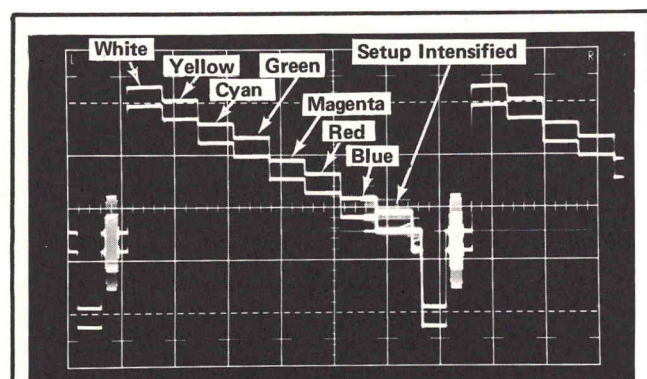
23. Check/Adjust Setup Level

a. Set the Type 1A5 Volts/Cm switch to .2 V and set the test oscilloscope Horizontal Display switch to B Intens By 'A'.

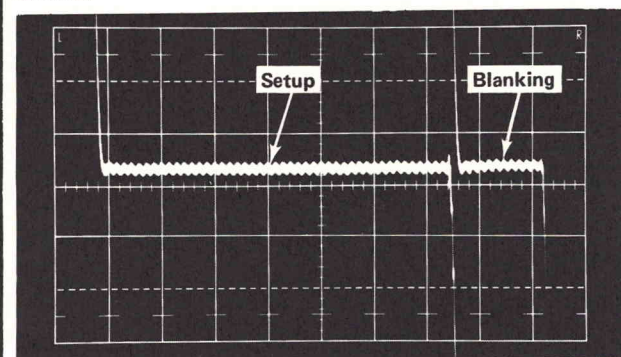
b. Set the Type R140 COLOR BAR R-Y and B-Y switches down and the Y, AMPL, and SETUP switches up.

c. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial settings of 0-3-58 each (71.4 mV).

d. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control until the setup level is intensified as shown in Fig. 5-27A.



(A) Luminance signal with setup intensified. To remove the dual displays, set the Type 1A5 B Input AC-GND-DC switch to GND.



(B) Setup level aligned with the blanking level.

Fig. 5-27. Typical displays used to check or adjust the setup level amplitude.

e. Set the test oscilloscope Horizontal Display switch to A Dly'd and the Type 1A5 Volts/Cm switch to 10 mV.

f. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the setup level of the lower display just aligns with the blanking level of the upper display; see Fig. 5-27B.

g. **CHECK—067-0596-00** calibration fixture V_2 Volts control dial setting; dial setting must be between 0-3-51 and 0-3-65 (71.4 mV, $\pm 1\%$).

h. Set the 067-0596-00 calibration fixture V_2 Volts control to a dial setting of 0-3-58.

i. **ADJUST—R433** (see Fig. 5-26) until the setup level of the lower display just aligns with the blanking level of the upper display.

j. Test equipment remains connected.

24. Check/Adjust Color Bar Luminance Levels

a. Set the Type R140 COLOR BAR AMPL switch to 100% and the SETUP switch to 0%.

b. Set the Type 1A5 Volts/Cm switch to .2 V and the test oscilloscope Horizontal Display switch to B Intens by 'A'.

c. Set the 067-0596-00 calibration fixture V_1 Range switch to 0.

d. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control to intensify the blanking level.

e. Set the Type 1A5 Volts/Cm switch to 10 mV. Then, observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the blue luminance level is aligned with the blanking level (see Fig. 5-27A for location of luminance levels).

f. **CHECK—067-0596-00** calibration fixture V_2 Volts control dial setting; dial setting must be between 0-7-80 and 0-7-96 (78.6 mV, $\pm 1\%$).

g. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 0-7-88.

h. ADJUST—R463 (see Fig. 5-26) until the blue luminance level aligns with the blanking level.

i. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the red luminance level aligns with the blanking level.

j. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 2-1-28 and 2-1-72 (214.3 mV, $\pm 1\%$).

k. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 2-1-50.

l. ADJUST—R453 until the red luminance level aligns with the blanking level.

m. Repeat part i using the green luminance level.

n. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 4-1-90 and 4-2-76 (421.4 mV, $\pm 1\%$).

o. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 4-2-34.

p. ADJUST—R454 until the green luminance level aligns with the blanking level.

q. Set the Type R140 WHITE REF switch to 100 IRE, AMPL switch to 75% and the SETUP switch to 10%.

r. Repeat part i using the white level.

s. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 7-1-02 and 7-2-48 (714.3 mV, $\pm 1\%$).

t. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 7-1-75.

u. ADJUST—R443 until the white level aligns with the blanking level.

v. Set the Type R140 COLOR BAR AMPL and SETUP switches down.

w. Using the preceding procedure to check and/or adjust the luminance levels, CHECK all remaining luminance levels listed in Table 5-4.

TABLE 5-4

Luminance Level		067-0596-00 Calibration Fixture
Component	Amplitude	V_2 Volts control Tolerance ($\pm 1\%$)
Yellow	641.6 mV	6-3-83 to 6-5-13
Cyan	516.1 mV	5-1-32 to 5-2-37
Magenta	324.5 mV	3-2-26 to 3-2-91
Blue ⁷	124.5 mV	1-2-36 to 1-2-61
Red ⁷	216.1 mV	2-1-33 to 2-1-70
Magenta ⁷	269.1 mV	2-6-74 to 2-7-28
Green ⁷	355.9 mV	3-5-39 to 3-6-11
Cyan ⁷	408.9 mV	4-0-64 to 4-1-47
Yellow ⁷	500.5 mV	4-9-75 to 5-0-76
White ⁷	553.6 mV	5-5-08 to 5-6-19

⁷Set the Type R140 COLOR BAR/AMPL, SETUP, AND WHITE REF switches up.

x. Test equipment remains connected.

25. Check/Adjust Full Field White Risetime and Aberrations 1

a. Set the Type 1A5 B Input AC-GND-DC switch to GND, Display switch to A-Vc, Volts/Cm switch to .1 V and rotate the Variable (Volts/Cm) control for a display amplitude of 5 cm between the blanking level and white level.

b. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control until burst and the white luminance level is intensified. Then, set the Horizontal Display switch to A Dly'd.

c. CHECK—Test oscilloscope display; aberrations on the leading top corner of the white bar must be less than or equal to 2% peak to peak.

d. Set the test oscilloscope Sweep Magnifier switch to X10.

e. CHECK—Test oscilloscope display; risetime must be 115 ns within 15%.

f. ADJUST—L466 and L456 (see Fig. 5-28) for a risetime of 115 ns within 15% with less than 2% aberrations.

g. Test equipment remains connected.

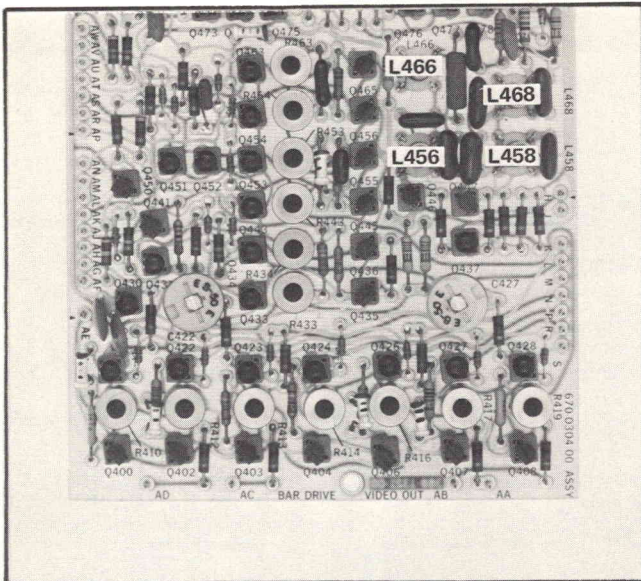


Fig. 5-28. Bar Drive and Video Out board adjustment locations.

26. Check/Adjust Split Field Timing

1

a. Set the Type 1A5 Volts/Cm switch to .2 V and the Variable (Volts/Cm) to Cal.

b. Set the test oscilloscope Horizontal Display switch to B Intens by 'A', Sweep Magnifier switch to off, and the Time Base A Time/Cm switch to .5 μ s.

c. Set the Type R140 COLOR BAR BARS switch to SPLIT FIELD.

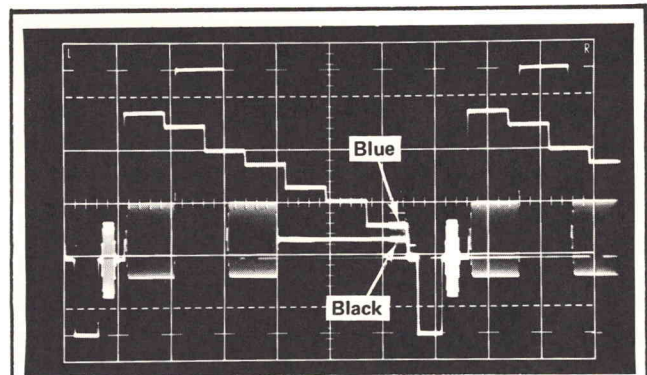
d. Observing the test oscilloscope display, rotate the Delay-Time Multiplier for a display as shown in Fig. 5-29A. Then, set the Horizontal Display switch to A DIY'd.

e. Set the Type 1A5 Volts/Cm switch to 50 mV.

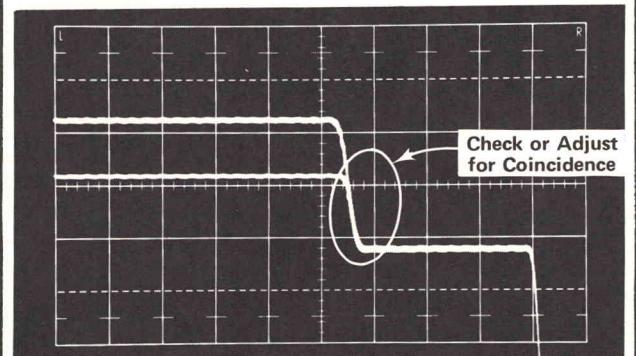
f. CHECK—Test oscilloscope display; Split Field blue bar and -I, W, Q, B black bar must have coincidence on fall time (see Fig. 5-29B).

g. ADJUST—C207 (see Fig. 5-30) until the falltime of the (Split Field) blue bar is coincident with the -I, W, Q, B black bar.

h. Set the Type 1A5 Volts/Cm switch to .2 V, the test oscilloscope Horizontal Display switch to B Intens By 'A' and the Sweep Magnifier switch to X10.



(A) Split Field display with blue and black bars intensified.



(B) Bars with proper coincidence.

Fig. 5-29. Typical SPLIT FIELD displays.

i. Observing the test oscilloscope display, rotate the Horizontal Position controls to center the Full Field cyan luminance level bar left and right of the horizontal center graticule line, as shown in Fig. 5-31.

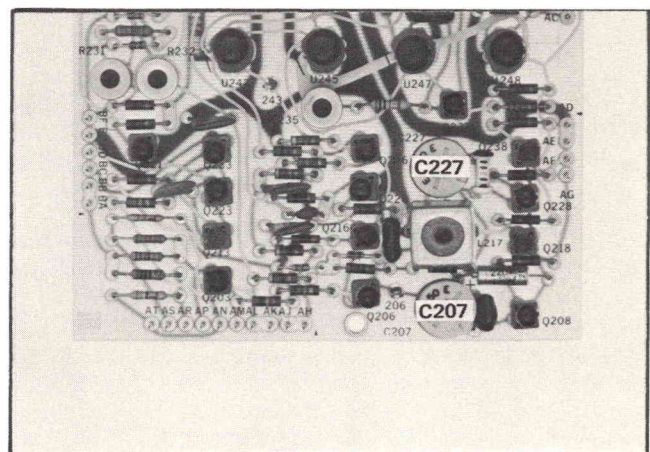


Fig. 5-30. Bar Timing board adjustment locations.

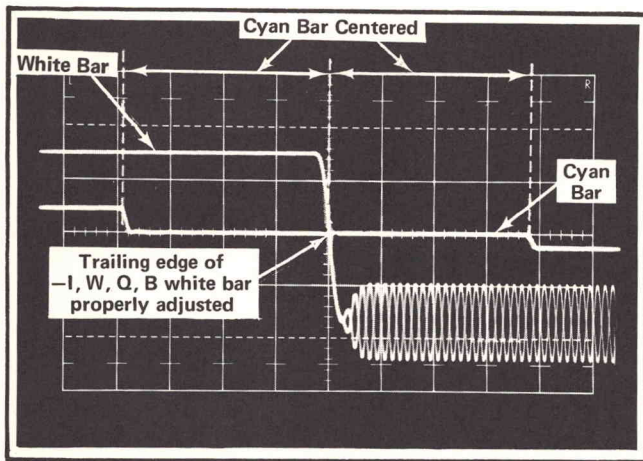


Fig. 5-31. Typical display used to adjust or check SPLIT FIELD bar timing.

j. CHECK—Test oscilloscope display; trailing edge of the $-I$, W , Q , B white bar must fall at the mid point on the Split Field cyan luminance level bar within 1% (9.4 μ s).

k. ADJUST—C227 until the trailing edge of the $-I$, W , Q , B white bar falls at the center of the Split Field cyan bar.

l. Test equipment remains connected.

27. Check/Adjust $-I$, W , Q , B White Bar Amplitude

a. Set the Type R140 COLOR BAR BARS switch to $-I$, W , Q , B ; then set the test oscilloscope Sweep Magnifier switch to Off.

b. Set the Type 1A5 Display switch to A-B and the B Input AC-GND-DC switch to DC.

c. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the white level (see Fig. 5-32) of the lower display just aligns with the blanking level of the upper display.

d. Set the Type 1A5 Volts/Cm switch to 10 mV and repeat part c.

e. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 7-1-02 and 7-2-48 (714.3 mV, $\pm 1\%$).

f. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of 7-1-75.

g. ADJUST—R434, see Fig. 5-26, until the $-I$, W , Q , B white level just aligns with the blanking level.

h. Test equipment remains connected.

28. Check/Adjust $-I$, W , Q , B White Bar Aberrations

a. Set the Type 1A5 Volts/Cm switch to .1 V, Display switch to A-Vc, and the B Input AC-GND-DC switch to GND. Then, rotate the Variable (Volts/Cm) control for a display amplitude of 5 cm between the blanking level and the white level.

b. CHECK—Test oscilloscope display; aberration on the leading top corner of the white bar must be less than or equal to 2% peak to peak.

c. Set the Test oscilloscope Sweep Magnifier switch to X10.

d. ADJUST—L458 and L468 (see Fig. 5-28) for the best square corner on the leading edge of the white bar with aberration less than 2% peak to peak.

e. Test equipment remains connected.

29. Check/Adjust $-I$ and Q Amplitudes

a. Set the test oscilloscope Sweep Magnifier switch to off.

b. Set the Type 1A5 Volts/Cm switch to .2 V, Variable (Volts/Cm) to Cal, Display switch to A-B, and the B Input AC-GND-DC switch to DC.

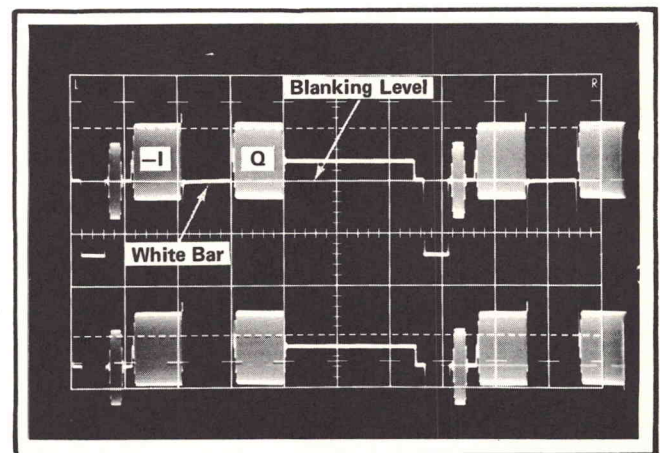


Fig. 5-32. Typical display to check or adjust the $-I$, W , Q , B white bar amplitude

Performance Check/Calibration—Type 140/R140

c. Set the 067-0596-00 calibration fixture V_1 Range switch to -1.1 V and the V_1 and V_2 Volts controls for dial settings of 1-4-33 each (285.7 mV).

d. Set the Type 1A5 Volts/Cm switch to 10 mV.

e. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the $-I$ signals just meet (see Fig. 5-32 for $-I$ and Q location).

f. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 1-3-51 and 1-5-23 (285.7 mV, $\pm 3\%$).

g. Note and record the dial setting of the 067-0596-00 calibration fixture V_1 and V_2 Volts controls dial settings.

h. Repeat parts e, f, and g using the Q signal.

i. CHECK—Sum of dial settings recorded in part g for the $-I$ and Q signals must be within 1% relative to each other.

NOTE

For Performance Check, proceed to part w.

j. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial setting of 1-1-98 each (239.6 mV).

k. Remove Q261; see Fig. 5-33.

l. ADJUST—R271 until the upper and lower Q signals just meet.

m. Replace Q261 and remove Q292.

n ADJUST—R232 until the upper and lower $-I$ signals just meet.

o. Replace Q292 and remove Q262.

p. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial settings of 0-7-80 each (155.6 mV).

q. ADJUST—R272 until the upper and lower $-I$ signals just meet.

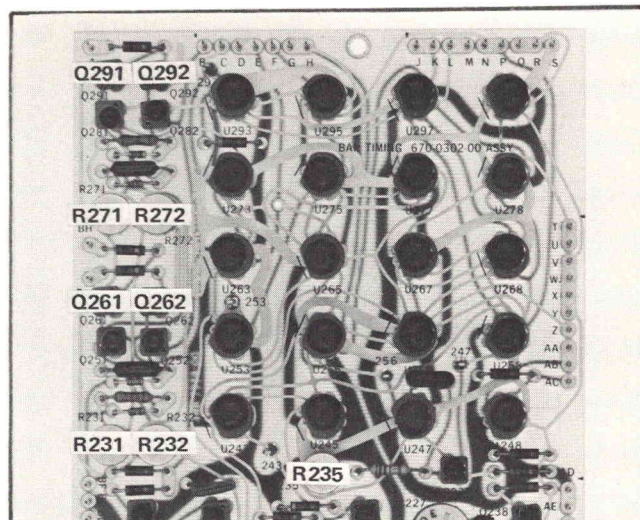


Fig. 5-33. Bar Timing board adjustment and transistor locations.

r. Replace Q262 and remove Q291.

s. ADJUST—R231 until the upper and lower Q signals just meet.

t. Replace Q291.

u. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial setting of 1-4-33 each.

v. Repeat (in listed order) parts e, f, g, h, and i.

w. Test equipment remains connected.

30. Check/Adjust Luminance to Chrominance Delay ①

NOTE

Throughout the Performance Check/Calibration procedure, if only a Performance Check is being performed, the Type R140 dust covers have not been removed. To accurately check and/or adjust the Luminance to Chrominance Delay (Step 30) and to Check Chrominance Risettime (Step 31), access to the Type R140 Line Timing board is necessary.

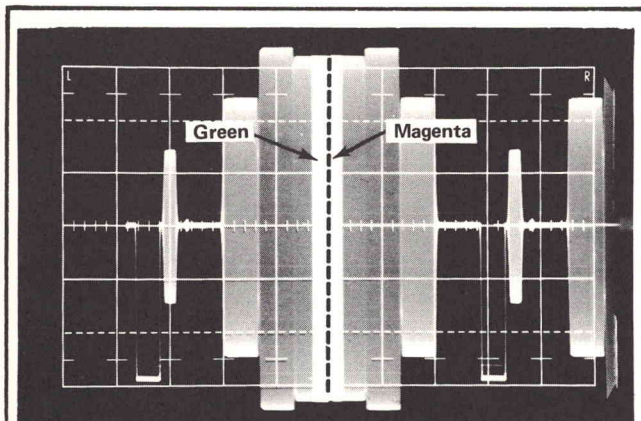
a. Set the Type R140 POWER switch OFF.

b. Remove the top dust cover (Performance Check Only) from the Type R140 and remove Q683; see Fig. 5-5.

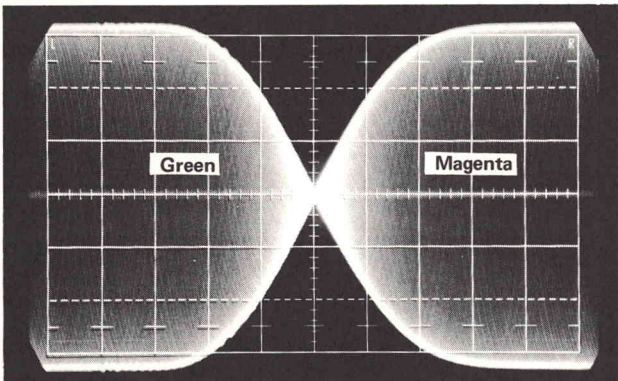
c. Set the Type R140 POWER switch ON.

d. Set the Type R140 COLOR BAR R-Y and B-Y switches up, Y switch down, SETUP switch to 0%, and the BARS switch to FULL FIELD.

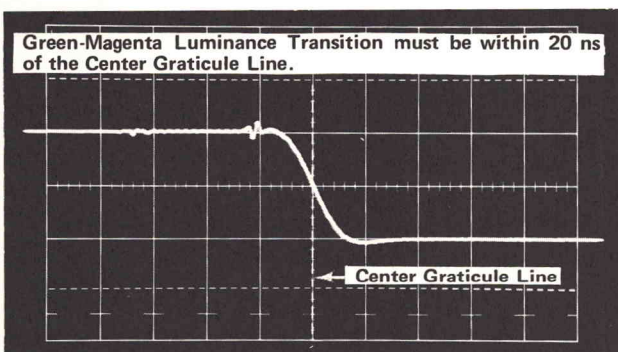
e. Set the Type 1A5 Volts/Cm switch to .1 V, B Input AC-GND-DC switch to GND, and the Display switch to A-Vc.



(A) Chrominance display with green and magenta intensified.



(B) Green-magenta transition properly positioned and centered on graticule.



(C) Luminance signal properly adjusted.

Fig. 5-34. Typical displays to check or adjust Luminance to Chrominance Delay.

f. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control to intensify the display as shown in Fig. 5-34A.

g. Set the test oscilloscope Horizontal Display switch to A Dly'd and the Sweep Magnifier switch to X5.

h. Observing the test oscilloscope display, rotate the Horizontal Position controls and the Type 1A5 Position control to center the green-magenta transition to the center of the graticule as shown in Fig. 5-34B.

NOTE

Do not move the test oscilloscope Delay-Time Multiplier or Horizontal Position controls until after the completion of this step.

i. Set the Type R140 COLOR BAR R-Y and B-Y switches down and the Y switch up.

j. Observing the test oscilloscope display, set the Type 1A5 Volts/Cm switch to 20 mV and the Variable (Volts/Cm) control for a 2 cm display amplitude. Then rotate the Position control to position the display vertically until the 50% point of the green-magenta luminance transition is at the center vertical graticule line on the test oscilloscope, as shown in Fig. 5-34C.

k. CHECK—Test oscilloscope display; green-magenta transition (at the 50% point) must be within 20 ns of the reference established in part h.

l. ADJUST—R235 (see Fig. 5-33) until the 50% point on the green-magenta transition is at the same point as the reference established in part h.

m. Test equipment remains connected.

31. Check Chrominance Risetime

a. Set the Type R140 COLOR BAR R-Y and B-Y switches up and the Y and AMPL switches down.

b. Set the test oscilloscope Horizontal Display switch to B Intens By 'A' and the Sweep Magnifier switch to Off.

c. Set the Type 1A5 Volts/Cm switch to 50 mV and rotate the Variable (Volts/Cm) control for a display amplitude of 5 cm between the blanking level and the flat top portion of the first color bar.

Performance Check/Calibration—Type 140/R140

d. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control to intensify the start of the first color bar. Then, set the Horizontal Display switch to A Dly'd and the Sweep Magnifier switch to X5.

e. CHECK—Test oscilloscope display; risetime of chrominance must be 375 ns within 15%.

f. Set the Type R140 POWER switch OFF.

g. Replace Q683 (removed in step 30).

h. Disconnect all test equipment.

Type R140 Controls

COLOR BAR	
R-Y	Up
B-Y	Up
Y	Up
AMPL	75%
SETUP	10%
WHITE REF	Up
BARS	FULL FIELD
VIDEO	Down
MOD STAIRCASE	
0° SUBCARRIER	Down
STEPS	UP
90° SUBCARRIER	OFF
APL/IRE LEVEL	50%
Vits	
FIELD	BOTH
SIGNAL	MOD STAIRCASE
LINE	15
CONVERGENCE	
CROSSHATCH	ON
DISPLAY	CROSSHATCH
VERT POSITION	Midrange
HORIZ POSITION	Midrange
SYNCHRONIZATION	
R-Y PHASE	90°
BURST	Up
SYNC	Up
REF	Up
SUBCARRIER PHASE	As is
POWER	ON

Test Oscilloscope Controls

Viewing	As desired
Time Base A	
Triggering Level	CCW, pushed in
Triggering	
Mode	AUTO
Slope	+
Coupling	AC
Source	Norm
Time/Cm	.5 μ s
Variable (Time/Cm)	Calibrated
Time Base B	
Triggering Level	Near 0, pushed in
Triggering	
Mode	Trig
Slope	—
Coupling	DC
Source	Ext
Time/Cm	10 μ s
Variable (Time/Cm)	Calibrated
Horizontal Display	
Sweep Magnifier	B
Single Sweep	Off
	Normal
Delay-Time Multiplier	Not used
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	DC
B Input AC-GND-DC	DC
Volts/Cm	.2 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

067-0596-00 Calibration Fixture

V₁	
Range	0
Volts	0-0-0
V₂	
Range	+1.1 V
Volts	1-4-35

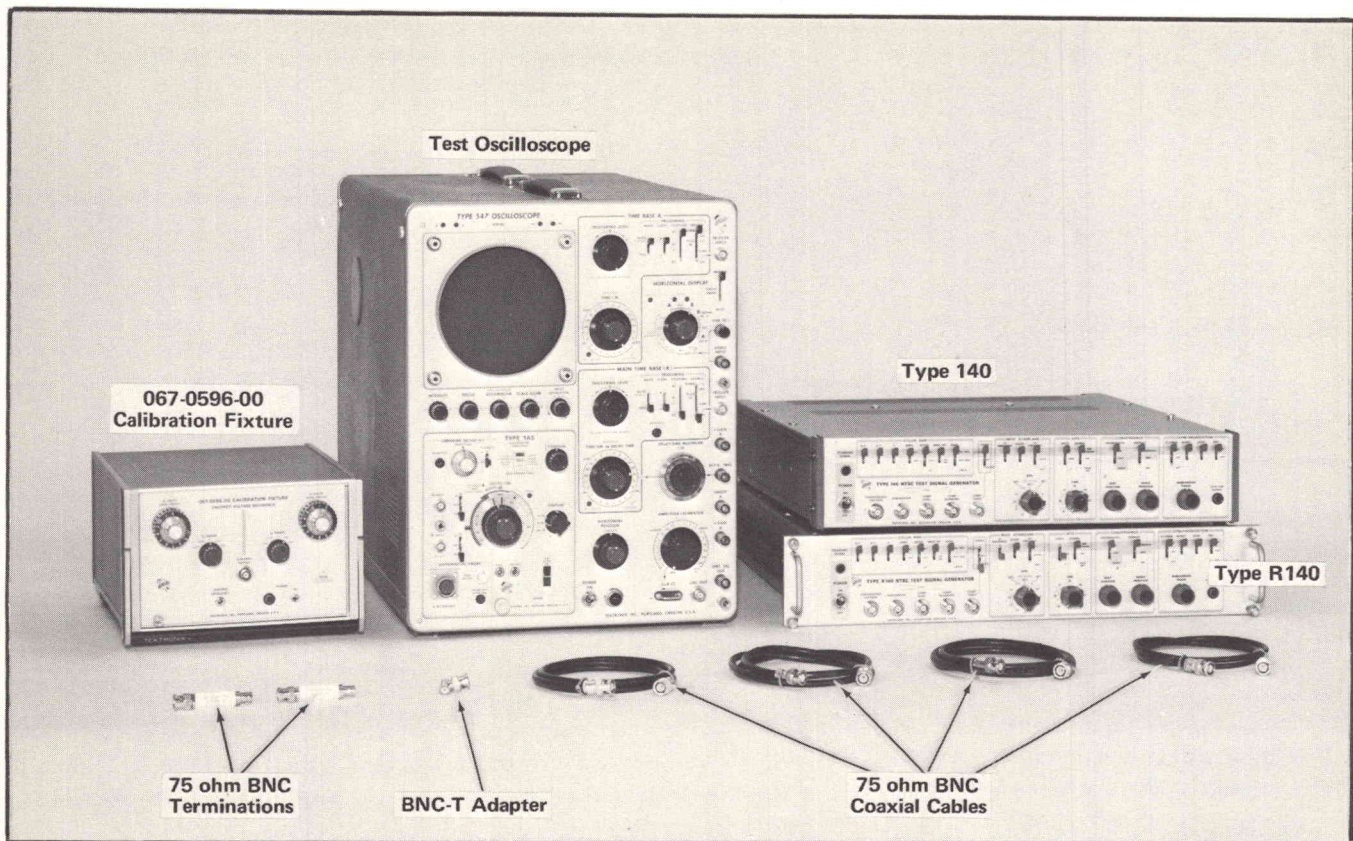


Fig. 5-35. Test equipment required for steps 32 through 42.

32. Check/Adjust Staircase Level Amplitudes ①

a. Test equipment is shown in Fig. 5-35.

b. From the Type R140 COMP VIDEO connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input Connector.

c. From the Type R140 rear-panel HORIZ DRIVE connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base B Trigger Input Connector.

d. From the 067-0596-00 calibration fixture Chopped Output connector, connect a 75 ohm coaxial cable to the Type 1A5 B Input connector.

e. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the first staircase level of the lower display aligns with the blanking level of the upper display as shown in Fig. 5-36.

f. Set the Type 1A5 Volts/Cm switch to 10 mV. Then, repeat part e.

g. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 1-4-18 and 1-4-48 ($142.86 \text{ mV} \pm 1\%$).

NOTE

Parts g through y check each step of the staircase signal for 142.86 mV , $\pm 1\%$ between steps. Parts z, aa and ab check the overall amplitude of the staircase signal. For complete calibration proceed to part ac.

h. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 1-4-33 (142.86 mV).

i. Set the 067-0596-00 calibration fixture V_1 Range switch to +1.1 V.

j. Rotate the 067-0596-00 calibration fixture V_1 Volts control for a dial setting of exactly 1-4-33.

NOTE

When the 067-0596-00 calibration fixture Volts controls are set for identical dial settings, the displays on the test oscilloscope appear as one.

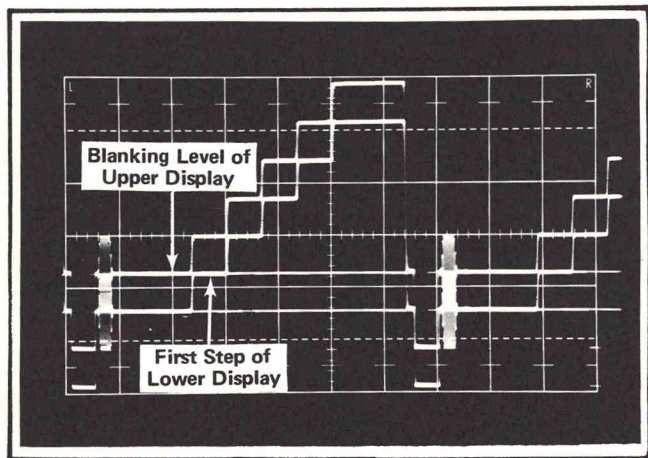


Fig. 5-36. Typical display to check or adjust staircase amplitudes.

k. Rotate the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 2-8-68 (285.72 mV).

l. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the first step exactly aligns with the second step.

m. CHECK—067-0596-00 calibration fixture V_1 Volts control dial setting; dial setting must be between 1-4-19 and 1-4-48. (Amplitude between step 1 and 2; 142.86 mV, $\pm 1\%$.)

n. Set the 067-0596-00 calibration fixture V_1 Volts control for a dial setting of exactly 2-8-68.

o. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 4-3-06 (428.58 mV).

p. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the second step aligns with the third step.

q. CHECK—067-0596-00 calibration fixture V_1 Volts control dial setting; dial setting must be between 2-8-39 and 1-8-93. (Amplitude between step 2 and 3; 142.86 mV, $\pm 1\%$.)

r. Set the 067-0596-00 calibration fixture V_1 Volts control for a dial setting of exactly 4-3-06.

s. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 5-7-42.

t. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the third step aligns with the fourth step.

u. CHECK—067-0596-00 calibration fixture V_1 Volts control dial setting; dial setting must be between 4-2-62 and 4-3-49. (Amplitude between step 3 and 4; 142.86 mV, $\pm 1\%$.)

v. Set the 067-0596-00 calibration fixture V_1 Volts control for a dial setting of exactly 5-7-42.

w. Set the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 7-1-75 (714.3 mV).

x. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_1 Volts control until the fourth step aligns with the fifth step.

y. CHECK—067-0596-00 calibration fixture V_1 Volts control dial setting; dial setting must be between 5-6-85 and 5-7-98. (Amplitude between step 4 and step 5, 142.86 mV, $\pm 1\%$.)

z. Set the 067-0596-00 calibration fixture V_1 Range switch to 0.

aa. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the fifth step exactly aligns with the blanking level.

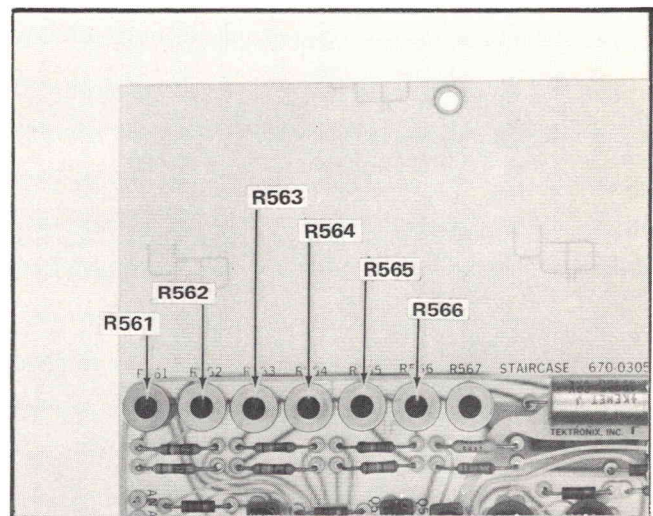


Fig. 5-37. Staircase board adjustment locations.

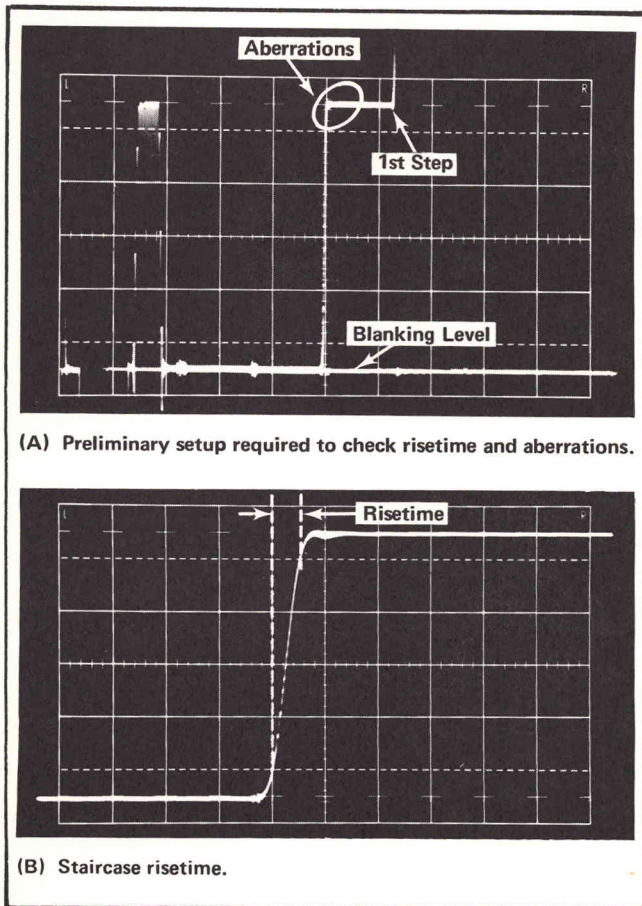


Fig. 5-38. Typical displays to check staircase aberrations and risetime.

ab. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 7-1-68 and 7-1-82 ($714.86 \pm 1\%$).

NOTE

Parts ac through am apply only as a calibration procedure. For performance check, proceed to part an.

ac. Rotate the 067-0596-00 calibration fixture V_2 Volts control for a dial setting of exactly 1-4-33.

ad. ADJUST—R562 (see Fig. 5-37) until the first step aligns with the blanking level as shown in Fig. 5-38A.

ae. Repeat part ac, using a dial setting of 2-8-68.

af. ADJUST—R563 until the second step aligns with the blanking level.

ag. Repeat part ac, using a dial setting of 4-3-06.

ah. ADJUST—R564 until the third step aligns with the blanking level.

ai. Repeat part ac, using a dial setting of 5-7-42.

aj. ADJUST—R565 until the fourth step aligns with the blanking level.

ak. Repeat part ac, using a dial setting of 7-1-75.

al. ADJUST—R566 until the fifth step aligns with the blanking level.

am. Do parts e through ab before proceeding to part an.

an. Test equipment remains connected.

33. Check Staircase Risetime and Aberrations

a. Set the Type 1A5 Volts/Cm switch to 20 mV, Display switch to A-Vc, B Input AC-GND-DC switch to GND, and rotate the Variable (Volts/Cm) control for a display amplitude of 5 cm, as indicated on the test oscilloscope, between the blanking level and the first step of the display.

b. Set the test oscilloscope Time Base B Time/Cm switch to 5 μ s and rotate the Horizontal Position control to position the first step as shown in Fig. 5-38A.

c. CHECK—Test oscilloscope display; aberrations on the front corner of the first step must be less than or equal to 2% peak to peak (of 5 cm display).

d. Set the test oscilloscope Sweep Magnifier switch to X10.

e. CHECK—Test oscilloscope display; risetime must be 260 ns within 15%, as shown in Fig. 5-38B.

f. Test equipment remains connected.

34. Check/Adjust Staircase Modulation

a. Set the Type 1A5 Volts/Cm switch to .2 V and the Variable (Volts/Cm) switch to Cal.

b. Set the test oscilloscope Horizontal Display switch to B Intens By 'A', Sweep Magnifier switch to Off, and the Time Base B Time/Cm switch to 10 μ s.

Performance Check/Calibration—Type 140/R140

c. Set the Type R140 MOD STAIRCASE 0° SUB-CARRIER switch up.

d. CHECK—Test oscilloscope display; 3.58 MHz modulation must be present on the staircase signal.

e. Rotate the test oscilloscope Delay-Time Multiplier control so that the intensified portion of the display is centered on the 2nd and 3rd staircase level as shown in Fig. 5-39A.

f. Set the test oscilloscope Horizontal Display switch to A Dly'd.

g. Set the 067-0596-00 calibration fixture V₂ Volts control for a dial setting of 1-4-33 (142.86 mV).

h. Set the Type 1A5 B Input AC-GND-DC switch to DC, Display switch to A-B, Volts/Cm switch to 50 mV, and rotate the Position control to position the display on the test oscilloscope as shown in Fig. 5-39B.

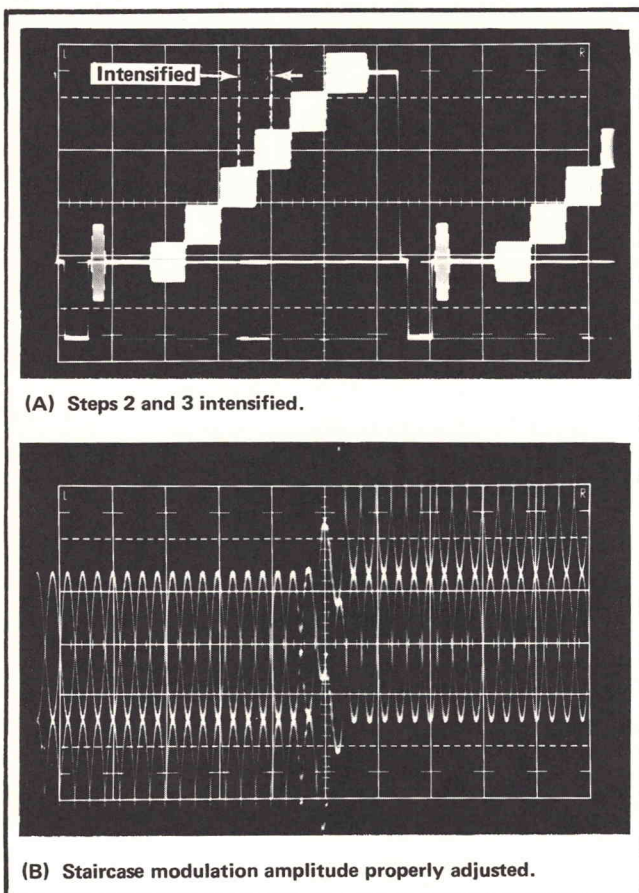


Fig. 5-39. Typical displays to check or adjust staircase modulation.

i. Set the test oscilloscope Horizontal Display Sweep Magnifier switch to X2.

j. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V₂ Volts control until the top of the bottom display just meets the bottom of the top display.

k. CHECK—067-0596-00 calibration fixture V₂ Volts control dial setting; dial setting must be between 1-3-90 and 1-4-76 (142.86 mV, $\pm 3\%$).

l. Set the 067-0596-00 calibration fixture V₂ Volts control for a dial setting of exactly 1-4-33.

m. ADJUST—R561 (see Fig. 5-37) until the top of the bottom display meets the bottom of the top display.

n. Test equipment remains connected.

35. Check Staircase Modulation Duration and Delay

a. Set the Type R140 MOD STAIRCASE STEPS switch down and the test oscilloscope Sweep Magnifier switch to off.

b. Set the Type 1A5 B Input AC-GND-DC switch to GND, Volts/Cm switch to 20 mV, Display switch to A-Vc, and rotate the Position control to center the display on the test oscilloscope.

c. Set the test oscilloscope Horizontal Display switch to B.

d. Set the Type 1A5 Variable (Volts/Cm) control for a display 2 cm in amplitude, as indicated on the test oscilloscope, between the start of the modulation and the most positive excursion of the modulation.

e. Set the test oscilloscope Horizontal Display switch to X2.

f. CHECK—Test oscilloscope display; duration of modulation must be 40 μ s within 5% as measured from the 50% points; see Fig. 5-40A.

g. Set the Type 1A5 Volts/Cm switch to 50 mV and rotate the Variable (Volts/Cm) control for a 4 cm display amplitude of the blanking pulse as shown in Fig. 5-40B.

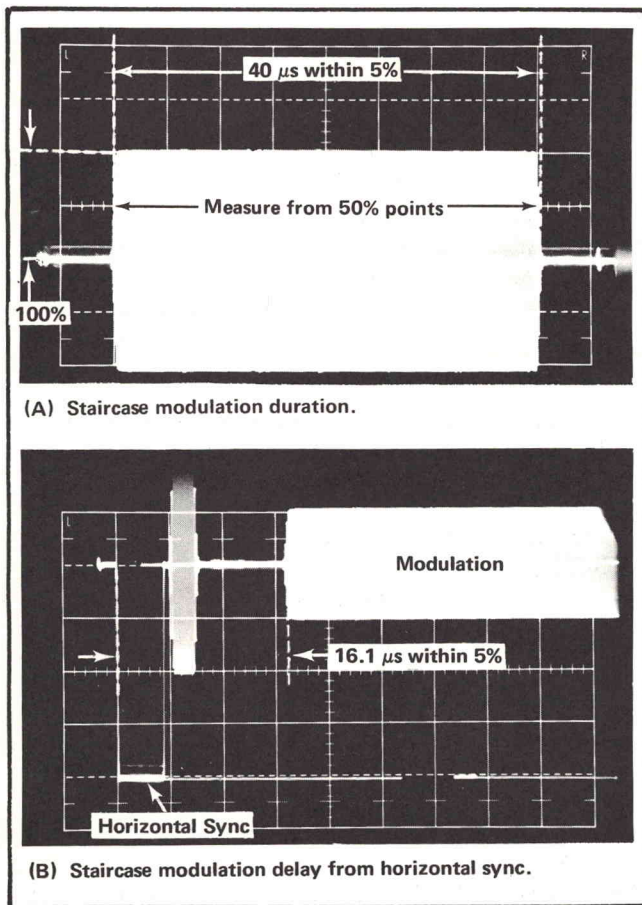


Fig. 5-40. Typical displays used to check staircase modulation duration and delay from H. Sync.

h. CHECK—Test oscilloscope display; subcarrier modulation must start $16.1 \mu\text{s}$ (within 5%) later than the horizontal sync.

i. Test equipment remains connected.

36. Check/Adjust Line Timing

①

a. Set the Type 1A5 Volts/Cm switch to .2 V and the Variable (Volts/Cm) switch to Cal.

b. Set the Type R140 COLOR BAR R-Y and B-Y switches down, VIDEO switch up, and the MOD STAIRCASE STEPS switch up.

c. Set the test oscilloscope Horizontal Display switch to B Intens By 'A', Time Base A Time/Cm switch to $2 \mu\text{s}$, Sweep Magnifier switch to Off, and rotate the Delay-Time Multiplier control to intensify the display as shown in Fig. 5-41A.

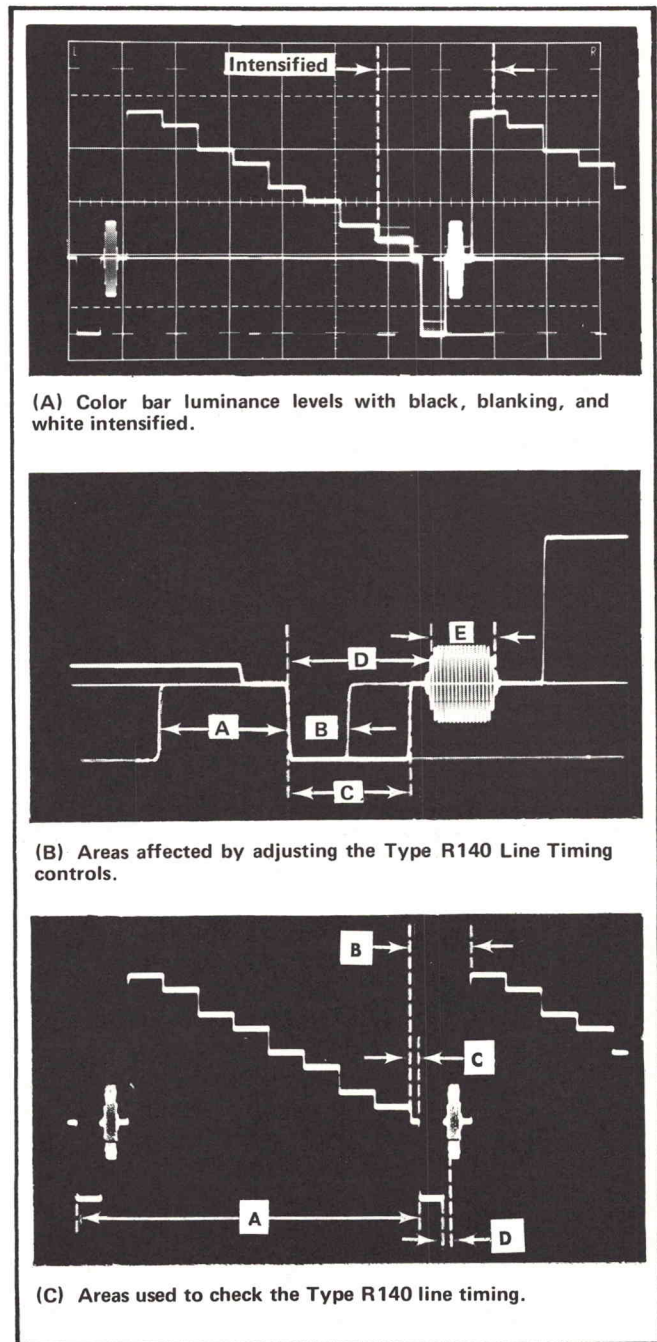


Fig. 5-41. Typical displays used to check or adjust line timing.

d. Set the test oscilloscope Horizontal Display switch to A Dly'd.

e. Using Fig. 5-41B and Fig. 5-42 as guides, CHECK and/or ADJUST all Line Timing listed in Table 5-5.

f. Set the test oscilloscope Horizontal Display switch to B.

TABLE 5-5

Area Affected (Fig. 5-41B)	Component	Timing		Adjust (Fig. 5-42)
		Exact	Tolerance	
A ⁸	Interval between Field Sync Pulses	4.5 μ s	4.3 to 4.7 μ s	R691
B ⁸	Equalizer Pulse Duration	2.33 μ s	2.28 to 2.38 μ s	R671
C	Line Sync Pulse Duration	4.71 μ s	4.66 to 4.76 μ s	R661
D	Burst Delay	5.0 μ s	4.75 to 5.25 μ s	R651
E	Burst Stop	2.4 μ s	2.22 to 2.61 μ s	R641

⁸It may be necessary to advance the test oscilloscope Intensity control to see this portion of this display.

g. Using Fig. 5-41C as a guide, CHECK all Timing listed in Table 5-6.

TABLE 5-6

Area Affected (Fig. 5-41C)	Component	Timing Check for:
A	Line Period	$\approx 63.5 \mu$ s
B	Line Blanking	$\approx 11.1 \mu$ s
C	Front Porch	1.54 μ s within 0.05 μ s
D	Breezeway	At least 379 ns

h. Disconnect the 75 ohm coaxial cable from the 067-0596-00 calibration fixture Chopped Output connector and the Type 1A5 B Input connector.

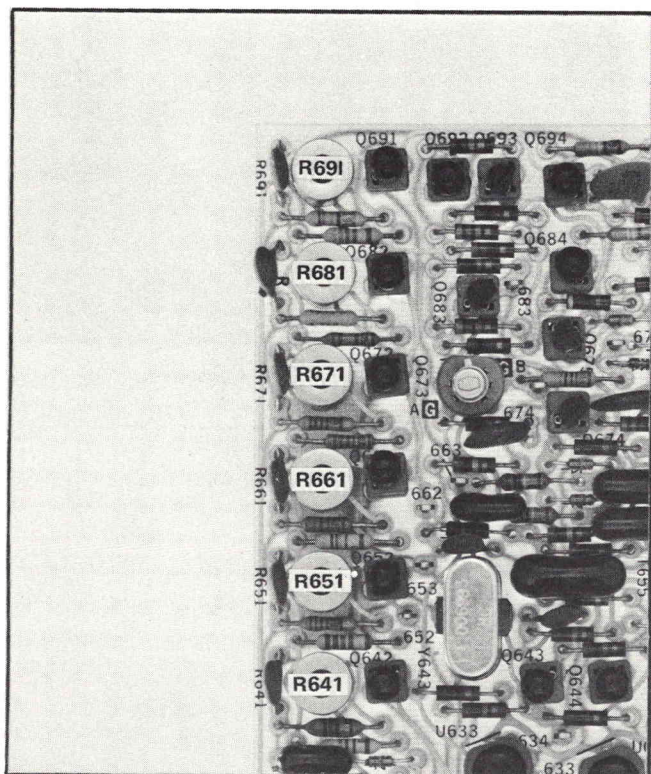


Fig. 5-42. Line Timing board adjustment locations.

i. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel HORIZ DRIVE connector.

j. Connect a BNC-T connector to the Type R140 rear-panel Loop-Thru COMP SYNC connector. Then, connect the 75 ohm coaxial cable disconnected in part i to one side of the BNC-T connector.

k. From the unused BNC-T connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 B Input connector.

l. Disconnect the 75 ohm coaxial cable from the Type R140 COMP VIDEO connector and reconnect it to the COMP SYNC connector.

m Set the Type 1A5 Volts/Cm switch to 20 mV, Display switch to A-B and the B Input AC-GND-DC switch to DC.

n. From the Comp Sync connector on another Type 140 (or video signal source capable of supplying composite sync of at least 2 to 8 volts peak to peak), connect a 75 ohm coaxial cable to the Type R140 rear-panel unused Loop-Thru COMP SYNC connector.

o. Set the type R140 SYNCHRONIZATION REF switch to EXT.

p. Set the test oscilloscope Horizontal Display Switch to B Intens By 'A', and rotate the Delay-Time Multiplier control to intensify the display as shown in Fig. 5-43A. Then, set the Horizontal Display switch to A Dly'd.

q. Rotate the test oscilloscope Horizontal Position controls and the Type 1A5 Position control to position the display as shown in Fig. 5-43B.

r. CHECK—Test oscilloscope display; positive and negative portions of the display must be equal, as shown in Fig. 5-43B.

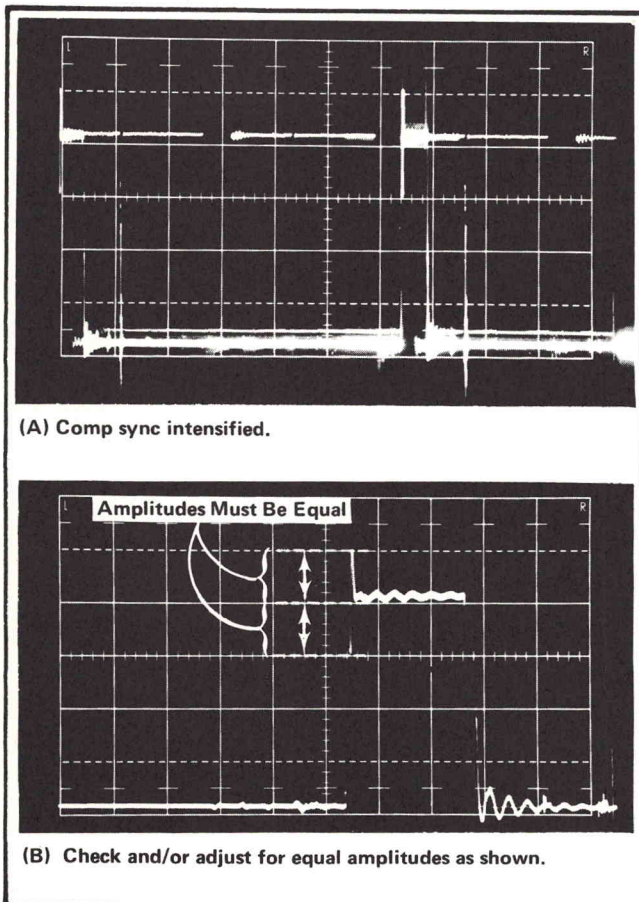


Fig. 5-43. Typical displays to check and/or adjust Comp Sync timing.

s. ADJUST—R681 (see Fig. 5-42) until the positive and negative portions of the display are equal.

t. Test equipment remains connected.

37. Check VITS and Selectable APL

a. Set the Type R140 SYNCHRONIZATION REF switch to INT.

b. Set the Type 1A5 Volts/Cm switch to .2 V, Display switch to A-Vc, and the B Input AC-GND-DC switch to GND.

c. Disconnect the 75 ohm termination from the Type 1A5 B Input connector, both 75 ohm coaxial cables from the BNC-T connector, and the BNC-T connector from the Type R140 rear-panel Loop-Thru COMP SYNC connector. Disconnect the 75 ohm coaxial cable from the Comp Sync connector on the other Type 140 and the Type R140 rear panel Loop-Thru COMP SYNC connector.

d. Disconnect the 75 ohm coaxial cable from the Type R140 COMP SYNC connector and reconnect it to the COMP VIDEO connector.

e. Connect the 75 ohm coaxial cable from the test oscilloscope Time Base B Trigger Input connector to the Type R140 rear-panel VERT DRIVE connector.

f. Set the test oscilloscope Horizontal Display switch to B Intens By 'A', Time Base A Time/Cm switch to 50 μ s and the Time Base B Time/Cm switch to 2 ms.

g. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control to intensify the display as shown in Fig. 5-44A. Then, set the Horizontal Display switch to A Dly'd.

h. Set the Type R140 COLOR BAR R-Y and B-Y switches up and the VIDEO switch down.

i. CHECK—Test oscilloscope display; there should be 1 staircase signal for each line sync pulse; see Fig. 5-44B.

j. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 10%/0.

k. CHECK—Test oscilloscope display; there should be 1 staircase signal every fifth line sync pulse; see Fig. 5-44C.

l. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 50% and the test oscilloscope Time Base B Time/Cm switch to 5 ms, and the Time Base A Time/Cm switch to .2 ms.

m. Observing the test oscilloscope display, rotate the Delay-Time Multiplier control until one of the Vertical Blanking intervals is displayed.

n. CHECK—Test oscilloscope display; VITS staircase signal must be present on the display in the area of the Vertical Blanking.

o. Set the Type R140 VITS SIGNAL switch to OFF.

p. CHECK—Test oscilloscope display; VITS signal must have been removed.

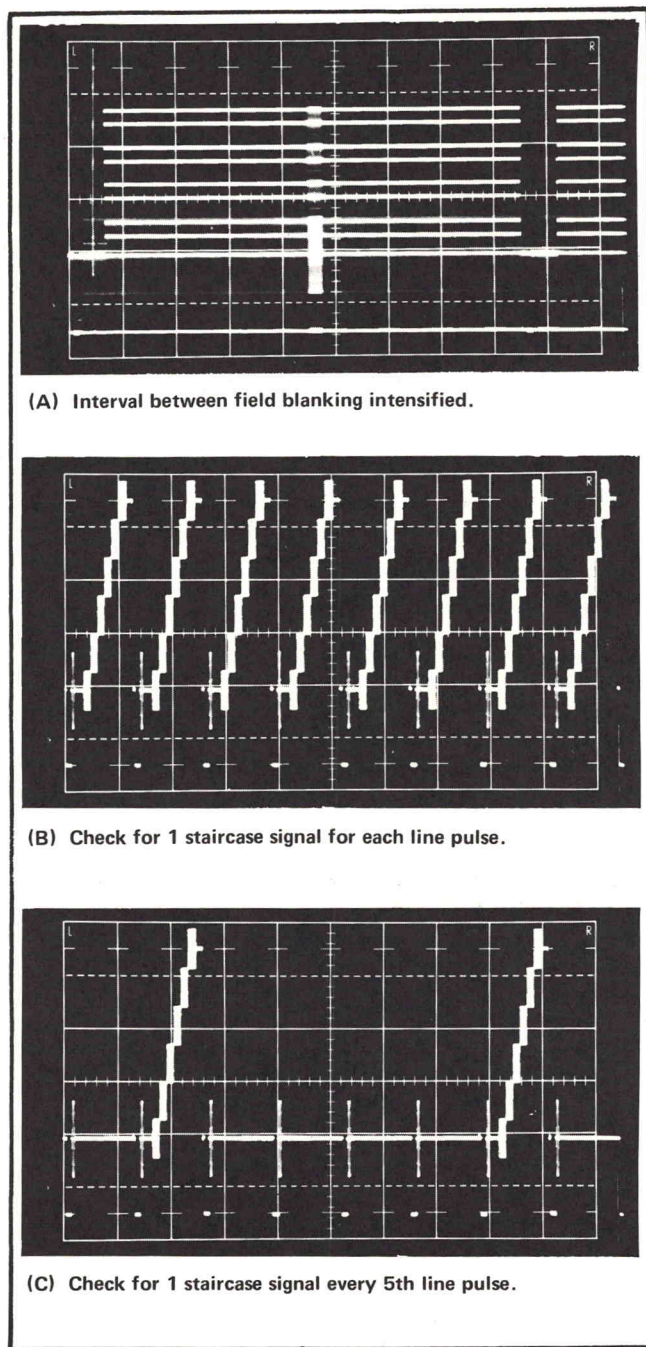


Fig. 5-44. Typical displays to check selectable APL operation.

q. Set the Type R140 VITS SIGNAL switch to COLOR BAR.

r. CHECK—Test oscilloscope display; VITS color bar signal must be present.

s. Observing the test oscilloscope display, set the Type R140 VITS FIELD switch to FIELD 1 or to FIELD 2.

t. CHECK—Test oscilloscope display; VITS signal must have been removed from the signal in either FIELD 1 or FIELD 2 position of the VITS FIELD switch.

u. Set the Type R140 VITS FIELD switch to that FIELD position which provides the VITS signal on the test oscilloscope display.

v. Determine the field to which the test oscilloscope has been set. For example, rotate the test oscilloscope Horizontal Position control to position the start of the Vertical Blanking pulse to the center graticule line. Set the Sweep Magnifier switch to X10 and check if the first equalizing pulse is preceded by a full line of video or 1/2 line of video. Field 1 will start with the first equalizing pulse following a complete line of video. Field 2 will start with the first equalizing pulse following 1/2 line of video.

w. CHECK—VITS signal must be present on that field to which the VITS FIELD switch has been set.

x. Set the test oscilloscope Sweep Magnifier switch to Off and rotate the Horizontal Position control to center the display on the test oscilloscope.

y. Observing the test oscilloscope display, rotate the VITS LINE switch through each position.

z. CHECK—Test oscilloscope display; VITS signal must be on the correct line to which the Type R140 VITS LINE switch is set.

aa. Set the Type R140 VITS FIELD switch to the opposite FIELD position.

ab. Observing the test oscilloscope display, rotate the Delay-Time Multiplier until the next Vertical Blanking Interval is displayed.

ac. CHECK—Test oscilloscope display; VITS signal must be present.

ad. Observing the test oscilloscope display, rotate the Type R140 VITS LINE switch through each position.

ae. Repeat part z.

af. Test equipment remains connected.

38. Check/Adjust Output Amplifiers**1**

a. Set the Type R140 VIDEO, VITS FIELD, and VITS SIGNAL switches up.

b. Set the test oscilloscope Horizontal Display switch to B, Time Base B Time/Cm switch to 10 μ s, Triggering Coupling switch to AC and the Triggering Source switch to Norm.

c. Set the Type 1A5 Volts/Cm switch to 1 V.

d. Disconnect the 75 ohm coaxial cable from the Type R140 COMP VIDEO connector and reconnect it to the COMP SYNC connector.

e. Rotate the test oscilloscope Triggering Level control for a triggered display.

f. CHECK—Test oscilloscope display; Signal must be at -4 Volts within 0.2 volt for approximately 4.7 μ s and at 0 volts for approximately 58.8 μ s.

g. Disconnect the 75 ohm coaxial cable from the Type R140 COMP SYNC connector and reconnect it to the rear-panel COMP SYNC connector.

h. Repeat part f.

i. Set the Type 1A5 Volts/Cm switch to .5 V and rotate the Variable (Volts/Cm) control for a display amplitude of 5 cm.

j. Set the test oscilloscope Time Base B Time/Cm switch to .5 μ s and the Sweep Magnifier switch to X10.

k. CHECK—Test oscilloscope display; risetime must be 115 ns within 10%.

l. Set the test oscilloscope Triggering Slope switch to +.

m. Repeat part k.

n. Set the test oscilloscope Time Base B Time/Cm switch to 10 μ s, Sweep Magnifier switch to X5 and the Triggering Slope switch to $-$.

o. ADJUST—L964 and L965 (see Fig. 5-45) for the best square corner on the display.

p. Set the test oscilloscope Sweep Magnifier switch to Off, the Type 1A5 Volts/Cm switch to 1 V, and the Variable (Volts/Cm) control to Cal.

q. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel COMP SYNC connector and reconnect it to the rear-panel COMP BLANKING connector.

r. CHECK—Test oscilloscope display; signal must be -4 volts within 0.2 volts for approximately 11.1 μ s and at 0 volts for approximately 52.4 μ s.

s. Disconnect the 75 ohm coaxial cable from the rear-panel COMP BLANKING connector and reconnect it to the COMP BLANKING connector.

t. Repeat parts (in listed order) r, i, j, k, l, k, and n.

u. ADJUST—L984 and L985 for the best square corner on the display.

v. Repeat part p.

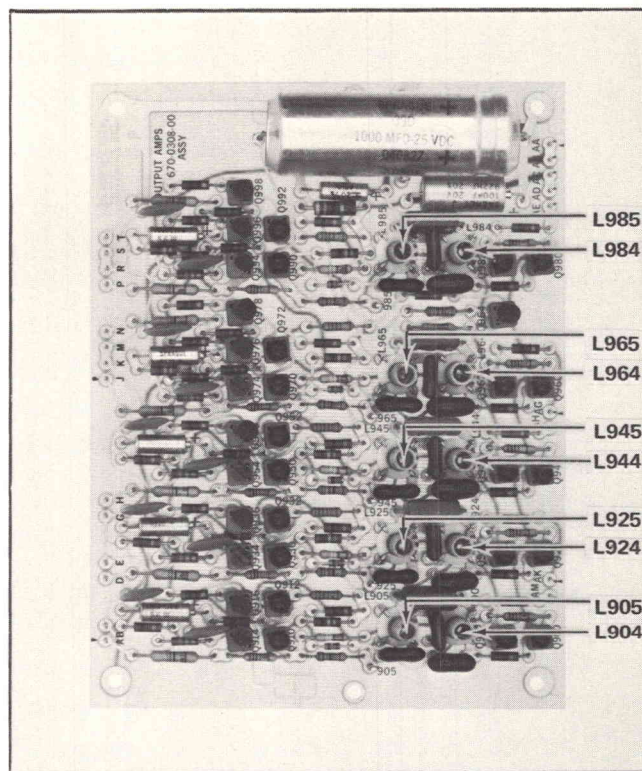


Fig. 5-45. Output Amps board adjustment locations.

Performance Check/Calibration—Type 140/R140

w. Disconnect the 75 ohm coaxial cable from the Type R140 COMP BLANKING connector and reconnect it to the rear-panel BURST FLAG connector.

x. CHECK—Test oscilloscope display; signal must be at -4 volts within 0.2 volts for 2.3 μ s within 5%, and at 0 volts for approximately 61 μ s.

y. Repeat parts (in listed order) j, k, l, k, and n.

z. ADJUST—L904 and L905 for the best square corner on the display.

aa. Repeat part p.

ab. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel BURST FLAG connector and reconnect it to the rear-panel HORIZ DRIVE connector.

ac. CHECK—Test oscilloscope display; signal must be at -4 volts within 0.2 volts for 6.35 μ s within 5%, and at 0 volts for approximately 57.21 μ s.

ad. ADJUST—L924 and L925 for the best square corner on the display.

ae. Repeat part p.

af. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel HORIZ DRIVE connector and reconnect it to the rear-panel VERT DRIVE connector.

ag. Set the test oscilloscope Time Base B Time/Cm switch to 2 ms.

ah. CHECK—Test oscilloscope display; signal must be at -4 volts within 0.2 volts for approximately 0.7 ms and at 0 volts for approximately 16.4 ms.

ai. Set the test oscilloscope Sweep Magnifier switch to X10.

aj. ADJUST—L944 and L945 for the best square corner on the display.

ak. Test equipment remains connected.

39. Check/Adjust Convergence Amplitudes 1

a. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel VERT DRIVE connector and reconnect it to the rear-panel CONVERGENCE PATTERN connector. Connect a second 75 ohm coaxial cable from the rear-panel HORIZ DRIVE connector to the test oscilloscope Time Base B Trigger Input connector.

b. Set the test oscilloscope Time Base B Time/Cm switch to 10 μ s, Triggering Source switch to Ext, and the Sweep Magnifier switch to Off.

c. Set the Type 1A5 Volts/Cm switch to .2 V, Display switch to A-B, and the B Input AC-GND-DC switch to DC.

d. Connect a 75 ohm coaxial cable from the 067-0596-00 calibration fixture Chopped Output connector to the Type 1A5 B Input connector.

e. Set the 067-0596-00 calibration fixture V_1 Range switch to -1.1 V, V_2 Range switch to +1.1 V, and the V_1 and V_2 Volts controls for dial settings of 5-0-20 each (1 V).

f. Set the Type 1A5 Volts/Cm switch to 20 mV.

g. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the top of the bottom display just aligns with the sync tip of the upper display.

h. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 4-5-22 and 5-5-27 (1 V, $\pm 5\%$).

i. Set the V_2 Volts control for a dial setting of 5-0-20.

j. ADJUST—R729 (see Fig. 5-46) until the top of the bottom display just aligns with the sync tip of the upper display.

k. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel CONVERGENCE PATTERN connector and reconnect it to the CONVERGENCE PATTERN connector.

l. Repeat parts g and h.

m. Set the Type 1A5 Volts/Cm switch to .2 V.

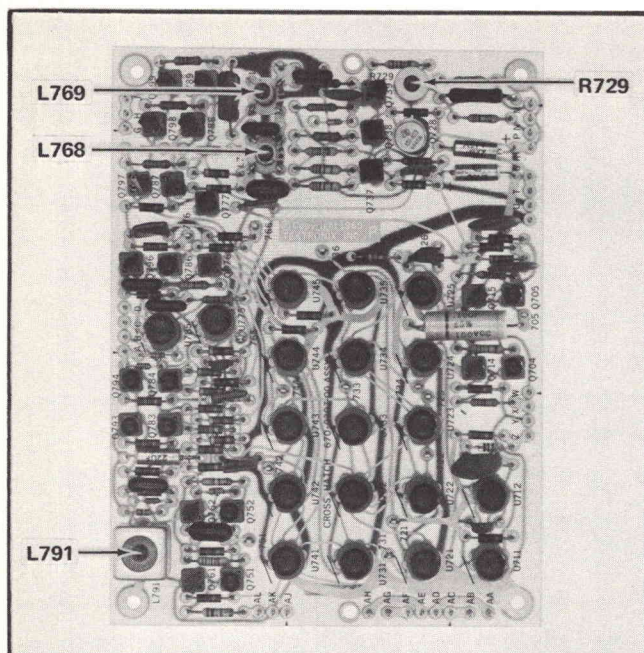


Fig. 5-46. Crosshatch board adjustment locations.

n. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial settings of 3-5-86 each (714 mV).

o. Set the Type 1A5 Volts/Cm switch to 50 mV.

p. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the top of the bottom display just aligns with the blanking level of the upper display.

q. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 3-2-26 and 3-9-42 (714 mV, $\pm 5\%$).

r. Repeat part m.

s. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial settings of 1-4-35 each (286 mV).

t. Repeat part o.

u. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the blanking level of the lower display just aligns with the sync tip of the upper display.

v. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 1-2-91 and 1-5-78 (286 mV, $\pm 5\%$).

w. Repeat part m.

x. Set the 067-0596-00 calibration fixture V_1 and V_2 Volts controls for dial settings of 0-3-61 each (72 mV).

y. Set the Type 1A5 Volts/Cm switch to 10 mV.

z. Observing the test oscilloscope display, rotate the 067-0596-00 calibration fixture V_2 Volts control until the setup level of the bottom display just aligns with the blanking level of the upper display.

aa. CHECK—067-0596-00 calibration fixture V_2 Volts control dial setting; dial setting must be between 0-3-25 and 0-3-97 (72 mV, $\pm 5\%$).

ab. Test equipment remains connected.

40. Check/Adjust Crosshatch Vertical Lines

a. Set the Type 1A5 Volts/Cm switch to .2 V, Display switch to A-Vc and the B Input AC-GND-DC switch to GND.

b. Set the Type R140 CONVERGENCE CROSSHATCH switch to VERT and the HORIZ POSITION control fully clockwise.

c. CHECK—Test oscilloscope display; there should be 17 vertical line pulses as shown in Fig. 5-47.

NOTE

For Performance Check, proceed to part i.

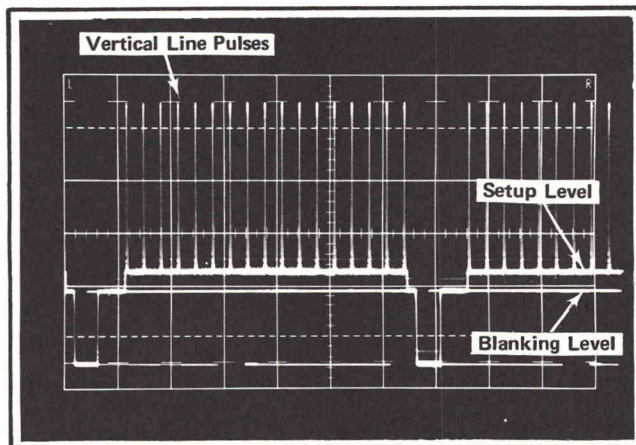


Fig. 5-47. Typical crosshatch display with vertical line pulses only.

Performance Check/Calibration—Type 140/R140

d. Set the test oscilloscope Sweep Magnifier switch to X10 and rotate the Horizontal Position control to position the first vertical line pulse within the viewing area of the graticule.

e. Note the horizontal distance (time) between the 50% point on the leading edge of setup and the peak of the first vertical line pulse.

f. Rotate the test oscilloscope Horizontal Position control until the 17th vertical line pulse is within the viewing area of the graticule.

g. Note the horizontal distance (time) between the peak of the 17th vertical line pulse and the 50% point on the trailing edge of setup.

h. **ADJUST—L791 (see Fig. 5-46) until the time between the seventeenth pulse and the trailing edge of the setup (see part g) matches the time between the leading edge of setup and the peak of the first vertical line pulse (see part e).**

i. (Performance Check Only) Set the test oscilloscope Sweep Magnifier switch to X10.

j. Rotate the test oscilloscope Horizontal Position control to align one of the vertical line pulses with a major vertical graticule line.

k. Observing the test oscilloscope display, rotate the Type R140 HORIZ POSITION control fully counterclockwise.

l. **CHECK—Test oscilloscope display; vertical line pulse must have moved at least 3.2 μ s from the reference established in part j.**

m. Set the Type 1A5 Volts/Cm switch to .1 V and rotate the Variable (Volts/Cm) control for a display amplitude of 4 cm between the setup level and the peak of the vertical line pulse.

n. Set the test oscilloscope Time Base B Time/Cm switch to 2 μ s.

o. **CHECK—Test oscilloscope display; vertical line pulse duration must be 225 ns within 15% as measured from the 50% points on the pulse.**

p. Set the test oscilloscope Sweep Magnifier switch to X5 and rotate the Horizontal Position control to position 2 pulses within the graticule viewing area.

q. Set the Type R140 CONVERGENCE DISPLAY switch to BOTH.

r. **CHECK—Test oscilloscope display; dot pulse must have been added to the display. Also, the dot pulse should be approximately midrange between the vertical line pulses.**

s. Set the Type R140 CONVERGENCE DISPLAY switch to DOT.

t. **CHECK—Test oscilloscope display; vertical line pulse must have been removed.**

u. Set the test oscilloscope Sweep Magnifier switch to X10.

v. **CHECK—Test oscilloscope display; dot pulse duration must be 350 ns with 15% as measured at the 50% points on the pulse.**

w. Test equipment remains connected.

41. Check Crosshatch Horizontal Lines

a. Set the Type 1A5 Volts/Cm switch to .2 V and the Variable (Volts/Cm) control to Cal.

b. Set the test oscilloscope Time Base B Time/Cm switch to 5 ms and the Sweep Magnifier switch to X2.

c. Disconnect the 75 ohm coaxial cable from the Type R140 rear-panel HORIZ DRIVE connector and reconnect it to the rear-panel VERT DRIVE connector.

d. Set the Type R140 CONVERGENCE CROSSHATCH switch to HORIZ, DISPLAY switch to CROSSHATCH and the VERT POSITION control fully clockwise.

e. **CHECK—Test oscilloscope display; there should be 14 horizontal line pulses per field.**

f. Set the test oscilloscope Sweep Magnifier switch to X10 and rotate the Horizontal Position control to position one of the pulses to a major vertical graticule line.

g. Observing the test oscilloscope display, rotate the Type R140 VERT POSITION control fully counterclockwise.

- h. CHECK—Test oscilloscope display; horizontal line pulse must have moved at least 1.1 ms from the reference established in part f.

- i. Test equipment remains connected.

42. Check/Adjust Convergence Risetime

- a. Disconnect the 75 ohm coaxial cable from the rear-panel VERT DRIVE connector and reconnect it to the rear-panel HORIZ DRIVE connector.

- b. Set the test oscilloscope Time Base B Time/Cm switch to 2 μ s and the Sweep Magnifier switch to Off.

- c. Observing the test oscilloscope display, set the Type 1A5 Volts/Cm switch to .1 V and rotate the Variable

(Volts/Cm) control for a display amplitude of 5 cm between the blanking level and the top of the horizontal line pulse.

- d. Set the test oscilloscope Sweep Magnifier switch to X10.

- e. CHECK—Test oscilloscope display; risetime must be 115 ns within 10%.

- f. ADJUST—L768 and L769 (see Fig. 5-46) for the best square corner on the horizontal line pulse.

- g. Repeat part e.

- #### h. Disconnect all test equipment and connections.

NOTES

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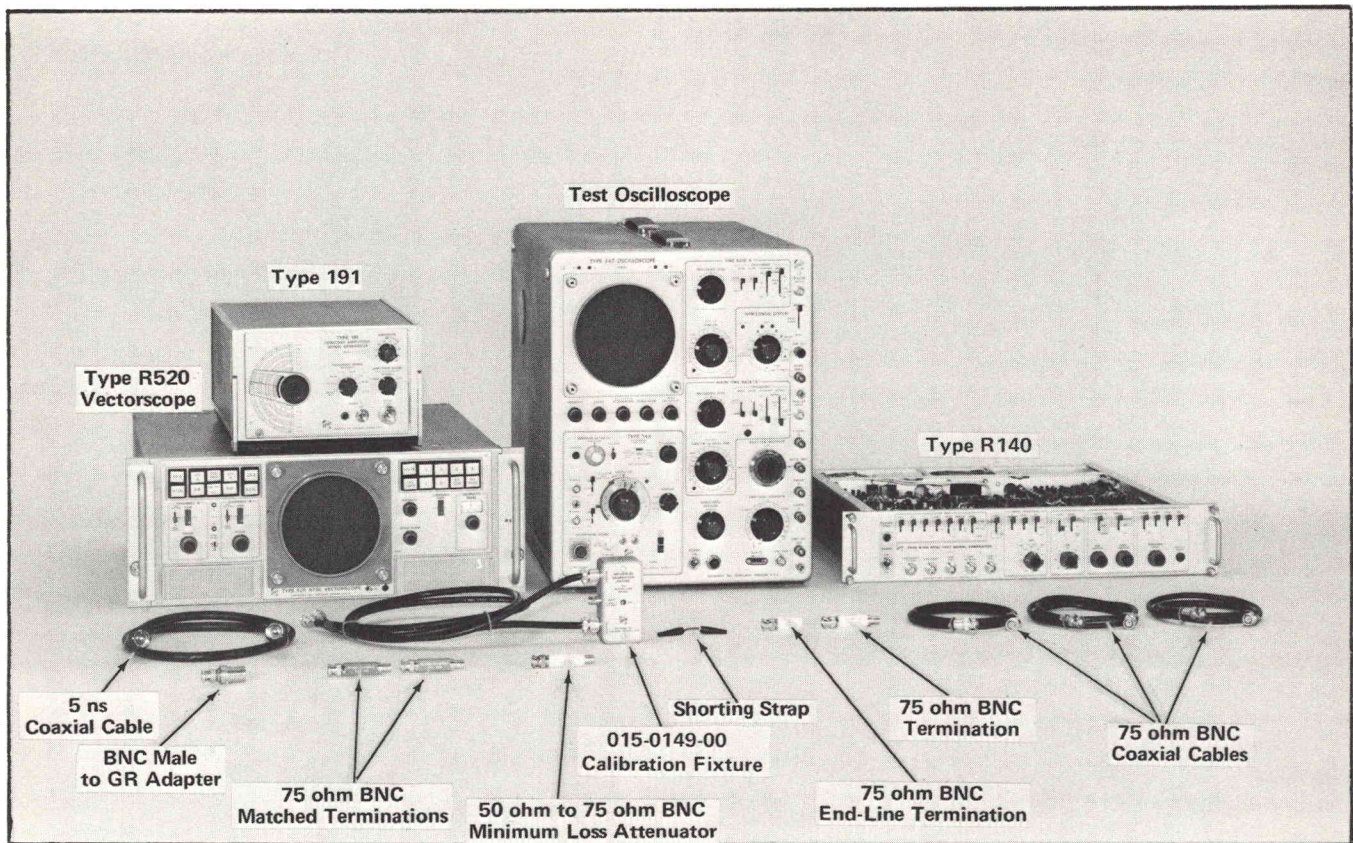


Fig. 5-48. Test equipment required for steps 43 through 46.

Type 140 Controls		CONVERGENCE	
COLOR BAR		CROSSHATCH	ON
R-Y	Up	DISPLAY	CROSSHATCH
B-Y	Up	VERT POSITION	Midrange
Y	Up	HORIZ POSITION	Midrange
AMPL	75%	SYNCHRONIZATION	
SETUP	10%	R-Y PHASE	90°
WHITE REF	Up	BURST	Up
BARS	FULL FIELD	SYNC	Up
		REF	Up
		SUBCARRIER PHASE	As is
VIDEO	Up	POWER	On
MOD STAIRCASE		Test Oscilloscope Controls	
0° SUBCARRIER	Up	Viewing	As desired
STEPS	Up	Time Base A	
90° SUBCARRIER	Off	Triggering Level	CCW, pushed in
APL/IRE LEVEL	50%	Triggering	
		Mode	Auto
VITS		Slope	+
FIELD	BOTH	Coupling	AC
SIGNAL	MOD STAIRCASE	Source	Norm
LINE	15		

Time/Cm Variable (Time/Cm)	.1 ms Calibrated
Time Base B	Not used
Horizontal Display	A
Sweep Magnifier	Off
Single Sweep	Normal
Delay-Time Multiplier	Not used
Horizontal Position	Midrange
Vernier (Horizontal Position)	Midrange
Power	On
Amplitude Calibrator	Off

Type 1A5 Controls

A Input AC-GND-DC	AC
B Input AC-GND-DC	AC
Volts/Cm	.1 V
Variable (Volts/Cm)	Cal
Display	A-B
Position	Midrange
Step Atten Bal	As is
Comparison Voltage	
Amplitude	0-0
Polarity	0

Vectorscope Controls

Signal Selector	CH A, FULL FIELD, A ϕ
Channel A	
100%-75%-Max Gain	75%
Gain	As is
Phase	As is
A Cal	Cal
Channel B	Not used
ϕ Ref	Ext
Function Selector	Vector
Intensity	As desired
Luminance Gain	Cal
Scale Illum	As desired
Calibrated Phase	0
Power	On
Left recessed front-panel controls	As is
Right recessed front-panel controls	As is

Type 191 Controls

Frequency	5 MHz
Frequency Range	50 kHz only
Amplitude	30
Variable (Amplitude)	\approx 45
Amplitude Range	.5-5 V
Power	On

43. (Calibration Procedure Only) Check Instrument Return Loss

- a. Test equipment is shown in Fig. 5-48.
- b. Connect one of the matched 75 ohm terminations to the 015-0149-00 calibration fixture Reference coaxial cable. Then, connect the 015-0149-00 calibration fixture to the Type 1A5 A and B Input connectors.
- c. From the Type 191 Constant Amplitude Signal Generator Output connector, in order, connect a 5 ns coaxial cable, BNC Male to GR adapter, and a 50 ohm to 75 ohm BNC Minimum Loss Attenuator to the Input connector on the 015-0149-00 calibration fixture.

d. Observing the test oscilloscope display, rotate the Type 191 Variable (Amplitude control for a display amplitude of 5 cm (500 mV).

e. Connect the second 75 ohm termination to the 015-0149-00 calibration fixture Unknown coaxial cable.

f. Set the Type 1A5 Volts/Cm switch to 1 mV; the Type 191 Frequency Range switch to 3.6-8 MHz.

g. CHECK—Test oscilloscope display; amplitude of display must be no more than 1 mV peak to peak.

h. Remove transistors Q902, Q922, Q942, Q962, and Q982 on the Type R140 Output Amplifier board; see Fig. 5-49.

i. Disconnect the 75 ohm termination connected in part e, then connect the 015-0149-00 calibration fixture Unknown coaxial cable to the Type R140 rear-panel BURST FLAG connector.

j. Set the Type 1A5 Volts/Cm switch to 5 mV.

k. CHECK—Test oscilloscope display; amplitude must be no more than 15 mV peak to peak (30 dB).

l. Repeat part k for the following Type R140 output connectors; rear-panel VERT DRIVE, HORIZ DRIVE, COMP SYNC, and COMP BLANKING, Front panel-COMP BLANKING and COMP SYNC.

m. Replace transistors Q902, Q922, Q942, Q962, and Q982.

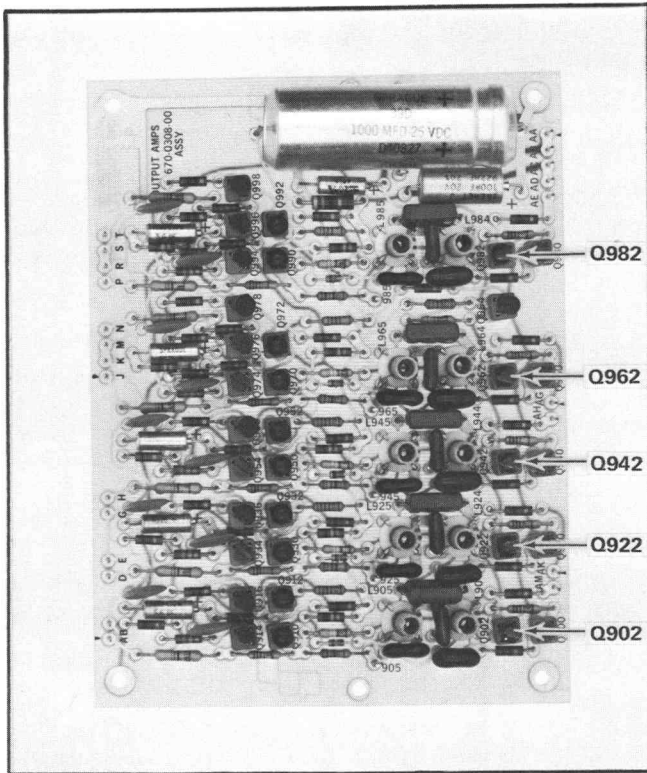


Fig. 5-49. Output Amplifier board transistor locations.

n. Set the Type R140 VIDEO switch to OFF and the SYNCHRONIZATION SYNC switch down.

o. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 COMP SYNC connector and reconnect it to the COMP VIDEO connector.

p. Repeat part k with the Type R140 POWER switch ON; then OFF.

q. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 front-panel COMP VIDEO connector and reconnect it to the rear-panel COMP VIDEO connector.

r. Repeat part k with the Type R140 POWER switch ON; then OFF.

s. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 rear-panel COMP VIDEO connector.

t. Set the Type R140 VIDEO switch up and the SYNCHRONIZATION SYNC switch up.

u. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable to the Type R140 rear-panel CONVERGENCE PATTERN connector.

v. Repeat part k. (Use the blanking level of the display as the measuring point.)

w. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 rear-panel CONVERGENCE PATTERN connector and reconnect it to the CONVERGENCE PATTERN connector.

x. Repeat part v.

y. Connect the 75 ohm termination (disconnected in part i) to one of the Type R140 rear-panel Loop-Thru COMP SYNC INPUT connectors. Then, disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 CONVERGENCE PATTERN connector and reconnect it to the other Loop-Thru COMP SYNC INPUT connector.

z. Set the Type 1A5 Volts/Cm switch to 1 mV.

aa. CHECK—Test oscilloscope display; amplitude of display must be no more than 2.5 mV peak to peak (46 dB).

ab. Disconnect the 75 ohm termination from the Type R140 rear-panel COMP SYNC INPUT connector and reconnect it to the rear panel SUBCARRIER INPUT connector.

ac. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the rear-panel COMP SYNC INPUT connector and reconnect it to the SUBCARRIER INPUT connector.

ad. Set the Type 191 Frequency Range switch to 1.6-3.6 and the Frequency control to 3.58 MHz.

ae. Repeat part aa.

af. Set the Type 1A5 Volts/Cm switch to 5 mV and the Type 191 Frequency Range switch to 3.6-8 MHz and the Frequency control to 5 MHz.

ag. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the rear-panel SUBCARRIER INPUT connector and reconnect it to the rear-panel SUBCARRIER connector.

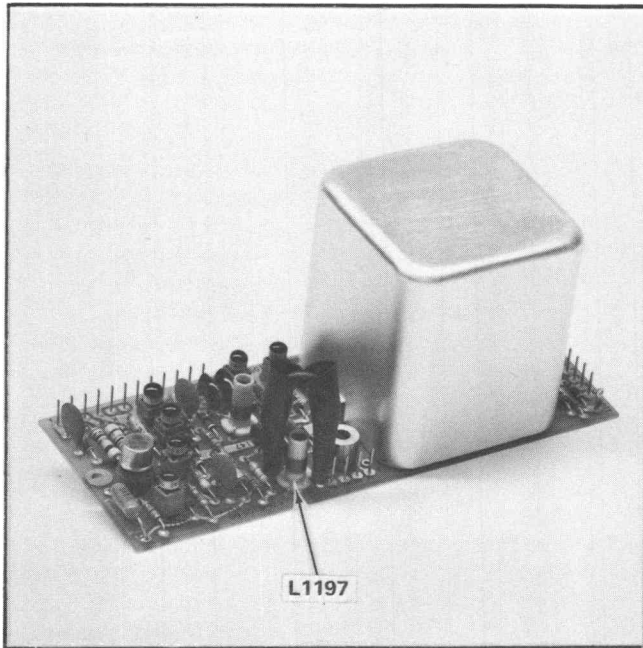


Fig. 5-50. L1197 on the Subcarrier Output board shorted. Used to check subcarrier return loss.

- ah. Set the Type R140 POWER switch to OFF.
- ai. Using a shorting strap, short L1197 on the Subcarrier Output board (see Fig. 5-50).
- aj. Set the Type R140 POWER switch to ON.
- ak. Repeat part k.
- al. Disconnect the 015-0149-00 calibration fixture Unknown coaxial cable from the Type R140 rear-panel SUBCARRIER connector and reconnect it to the SUBCARRIER connector.
- am. Repeat part k.
- an. Set the Type R140 POWER switch to OFF. Remove the short connected in part ai. Then, set the Type R140 POWER switch to ON.
- ao. Disconnect the 015-0149-00 calibration fixture from the Type 1A5 A and B Input connectors, the Unknown coaxial cable from the Type R140 SUBCARRIER connector, the 75 ohm termination from the Type 140 rear-panel Loop-Thru SUBCARRIER INPUT connector, and the 50 ohm to 75 ohm Minimum Loss Attenuator from the 015-0149-00 calibration fixture Input connector.

44. Check Jitter

- a. Set the Type 1A5 Volts/Cm switch to .5 V, A Input AC-GND-DC switch to DC, and the B Input AC-GND-DC switch to GND.
- b. Set the test oscilloscope Time Base A Time/Cm switch to .1 μ s, Triggering Mode switch to Trig, Triggering Slope switch to —, Triggering Coupling switch to DC and the Trigger Source switch to Ext.
- c. From the Type R140 SUBCARRIER connector, connect a 75 ohm coaxial cable and a 75 ohm termination to the Type 1A5 A Input connector.
- d. From the Type R140 COMP SYNC connector, connect a 75 ohm coaxial cable to the test oscilloscope Time Base A Trigger Input connector.
- e. Rotate the test oscilloscope Triggering Level control for a triggered display. Then, set the Sweep Magnifier switch to X10.

f. CHECK—Test oscilloscope display; display jitter must be less than or equal to 4 ns.

- g. Test equipment remains connected.

45. Check Diff Gain and Diff Phase

- a. Connect a 75 ohm end-line termination to the Type R520 Vectorscope Channel A J2 connector.
- b. Disconnect the 75 ohm coaxial cable from the 75 ohm termination on the Type 1A5 A Input connector and the Type R140 SUBCARRIER connector.
- c. Connect a 75 ohm coaxial cable from the Type R140 COMP VIDEO connector to the Type R520 Channel A J1 connector.
- d. Set the Type R140 VIDEO switch down.
- e. Observing the Vectorscope display, rotate the Channel A Phase control to align the burst vector at 180° and the staircase vector at 0° as shown in Fig. 5-51A.
- f. Set the Type R520 Vectorscope Channel A 100%-75%-Max Gain switch to Max Gain, and rotate the Channel A Gain control until the staircase vector just lies on the compass rose of the vector graticule as shown in Fig. 5-51B. (Use the Channel A Phase control to align the staircase vector at 0° if necessary.)

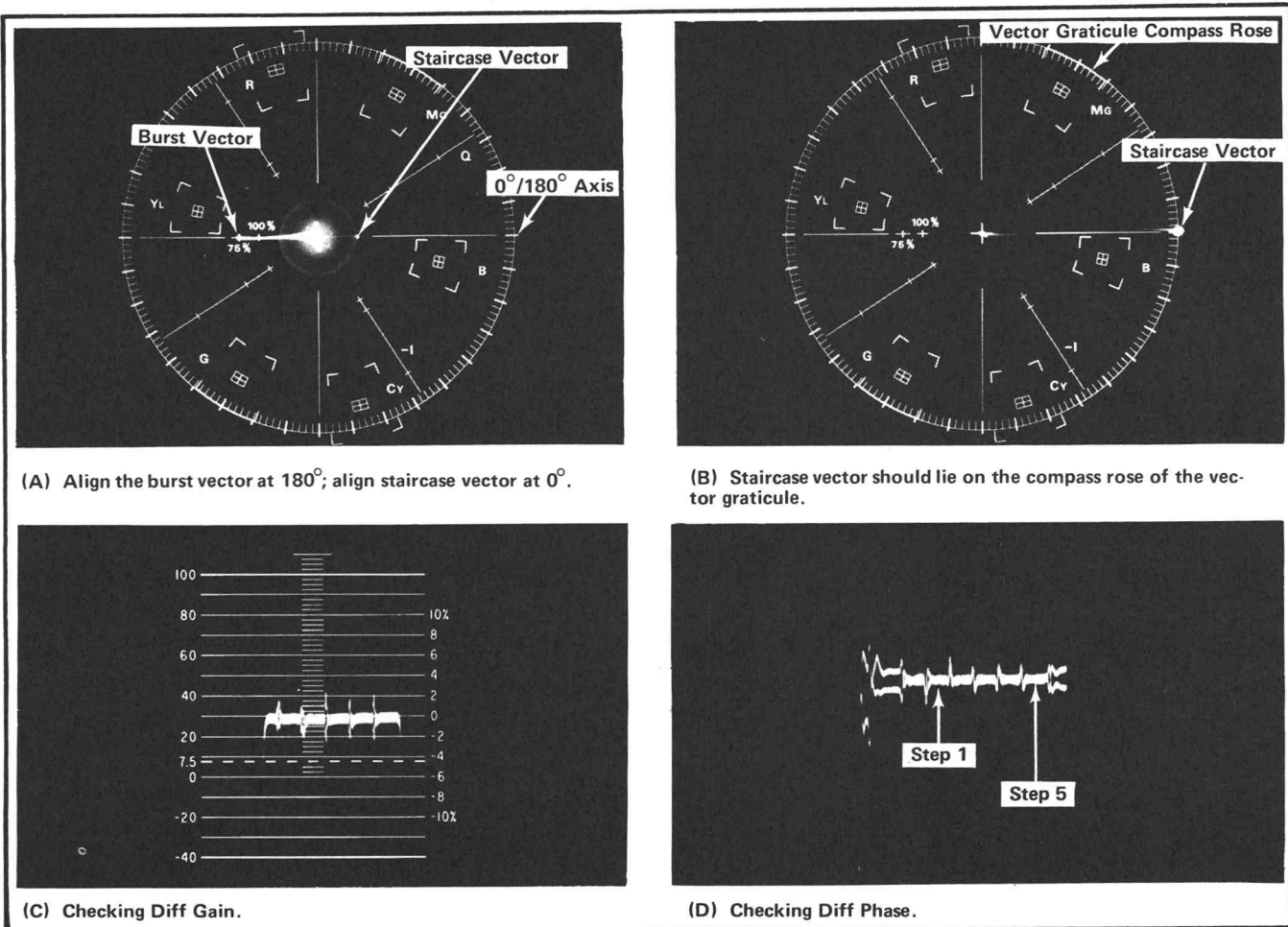


Fig. 5-51. Typical displays used to check differential gain and phase.

g. Check that the burst and staircase vectors start from the center of the vector graticule. If they do not, adjust the Type R520 Horizontal and Vertical Position Clamp controls until the Vectors start from the center of the vector graticule, then repeat parts e and f.

h. Press the Type R520 Diff Gain pushbutton.

i. Rotate the Type R520 Vertical Position control to position the display as shown in Fig. 5-51C.

j. CHECK—Type R520 Vectorscope display; Diff Gain must be less than 0.5% as measured on the Diff Gain scale.

k. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 10%/0.

l. Repeat part j.

m. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 90%/100.

n. Repeat part j.

o. Press the Type R520 Vectorscope Diff Phase pushbutton; set the Type R140 MOD STAIRCASE 90° SUB-CARRIER switch to UNMOD.

p. Check that the Type R520 Vectorscope Calibrated Phase Dial is set to 0.

q. Rotate the Type R520 Vectorscope A Phase control to center the display and then use the same control as a coarse adjustment to null the first step on the display as shown in Fig. 5-51D.

r. Rotate the Type R520 Vectorscope Calibrated Phase control to again null the first step.

Performance Check/Calibration—Type 140/R140

w. CHECK—Diff Phase, resultant noted in part v must be less than 0.1° .

x. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 50%.

y. Repeat parts p through w.

z. Set the Type R140 MOD STAIRCASE APL/IRE LEVEL switch to 10%/0.

aa. Repeat part y.

ab. Test equipment remains connected.

46. Check Color Bar Vectors

a. Set the Type R140 VIDEO switch up.

b. Set the Type R520 Vectorscope Channel A Gain control to Cal, 100%-75%-Max Gain switch to 75%, and press the Vector pushbutton.

c. Observing the Type R520 Vectorscope display, rotate the Channel A Phase control to align the burst vector at 180° .

d. CHECK—Type R520 Vectorscope display; all vector tips must lie within their respective inner boxes on the vector graticule as shown in Fig. 5-52A. Also, the burst vector tip must be at the 75% mark.

e. Set the Type R140 COLOR BAR BARS switch to -I, W, Q, B.

f. CHECK—Type R520 Vectorscope display; display must be as shown in Fig. 5-52B.

g. Disconnect all test equipment and connections.

This completes the Performance Check/Calibration procedure. Install the Type R140 top and bottom dust covers (Calibration Procedure Only).

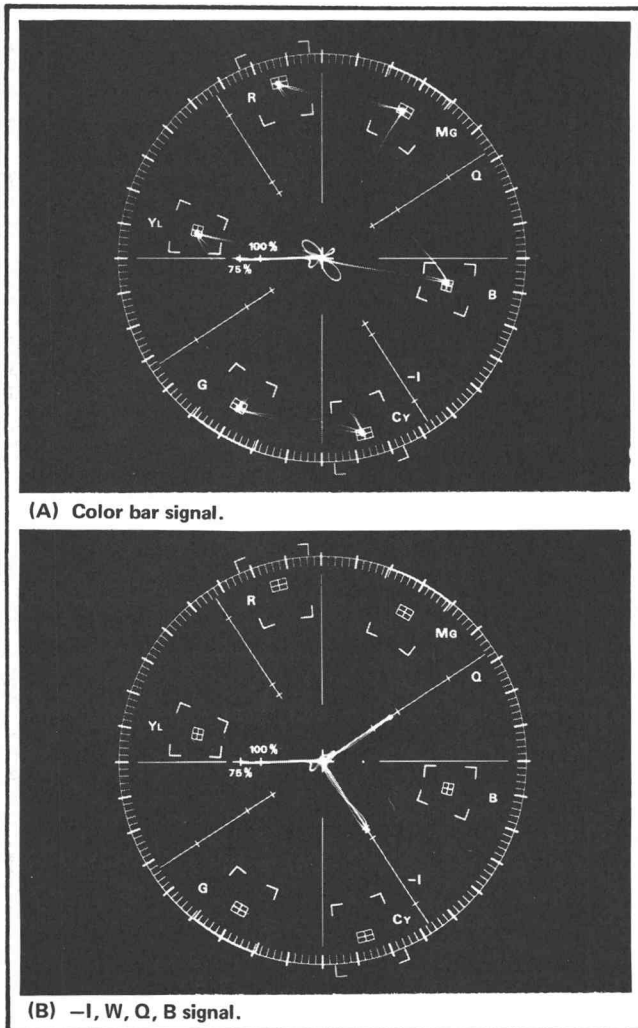


Fig. 5-52. Typical Vectorscope displays at the color bar and -I, W, Q, B signals.

NOTE

The Calibrated Phase control is used as a vernier adjustment.

s. Note and record the Type R520 Vectorscope Calibrated Phase dial setting.

t. Rotate the Type R520 Vectorscope Calibrated Phase control to null the fifth step.

u. Note and record the Type R520 Vectorscope Calibrated Phase dial setting.

v. Subtract the dial readings obtained in parts s and u.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

SECTION 6

RACKMOUNTING

Change information, if any, affecting this section will be found at the rear of the manual.

RACKMOUNTING INSTRUCTIONS

Mounting Methods (Figs. 6-1, 6-2, 6-5 and 6-6)

This instrument will fit most commercial consoles and most 19-inch wide racks whose front and rear rail holes conform to Universal, EIA, RETMA and Western Electric hole spacing.

Fig. 6-1 shows the instrument installed in a cabinet type rack with 1 3/4-inch wide slide-out tracks for a non-tilt installation. The instrument is secured into the rack by means of four captive thumb screws. When the thumb screws on the front panel are loosened, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 6-2). This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack.

The slide-out tracks easily mount to the cabinet rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10 1/2 inches to 24 1/2 inches. Some means of support (for example, make extensions for the rear mounting brackets) is needed for the rear ends of the slide-out tracks if the tracks are going to be installed in a cabinet rack whose inside dimension between front and rear rails is not the proper distance (10 1/2 inches to 24 1/2 inches).

Instrument Dimension

The last page in this section shows dimensional drawings exclusive of the power cord and cables.

Width—A standard 19-inch rack may be used. The dimension or opening between the front rails must be at least 17 5/8 inches (see Fig. 6-2) for a cabinet rack in which the front lip of the stationary section is mounted behind an untapped front rail as shown in the right-hand illustration of Fig. 6-6. This dimension allows room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

Depth—For proper circulation of cooling air, allow at least 2 inches clearance behind the rear of the instrument and any enclosure on the rack (see dimensional drawing). If

it is sometimes necessary or desirable to operate the Type R140 in the fully extended position, use cables that are long enough to reach from the instrument to the location where the signal(s) need to be applied.

Rackmounting in a Cabinet Rack

General Information—The slide-out tracks for the instrument consist of two assemblies, one for the left side of the instrument and one for the right side. Each assembly consists of three sections as illustrated in Fig. 6-3. The stationary section attaches to the front and rear rails of the rack with inside dimensions as indicated in Fig. 6-2; the chassis section attaches to the instrument and is installed at the factory; the intermediate section fits between the other two sections to allow the instrument to be fully extended out of the rack.

The small hardware components included with the slide-out track assemblies are shown in Fig. 6-4. The hardware shown in Fig. 6-4 is used to mount the slide-out tracks to the rack rails having this compatibility.

(a) Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting holes (see Fig. 6-6).

(b) Front rail holes may have already been countersunk prior to this installation.

Because of the compatibility given in (b), there will be some screws left over.

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets for both sides including hardware are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop are located near the top of the matched sets when they are properly mated to the chassis sections as shown in Fig. 6-3.

Mounting Procedure—Use the following procedure to mount both sets. See Figs. 6-5 and 6-6 for installation details.

Rackmounting—Type 140/R140

1. To mount the instrument directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 6-5 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front rails are not countersunk, use the pan head screws and bar nuts to mount the stationary sections similar to the right-hand illustration shown in Fig. 6-6.

(b) If the front rails are countersunk, use the flat head screws and bar nuts to mount the stationary sections as shown in Fig. 6-6 right-hand illustration.

3. Mount the stationary slide-out track sections to the non-tapped rear rails using this method:

Mount the left stationary section with hardware provided as shown in the left-hand or center illustration in Fig. 6-6. Note that the rear mounting bracket can be installed

either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 6-6 as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

Adjustments

To adjust the slide-out tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as described and as shown in steps 1 through 4 of Fig. 6-7 installation procedure.

2. Adjust the slide-out tracks for proper spacing as shown in Fig. 6-8.

Maintenance

The slide-out tracks require no lubrication. The special dark gray finish on the sliding parts is a permanent lubrication.

NOTES

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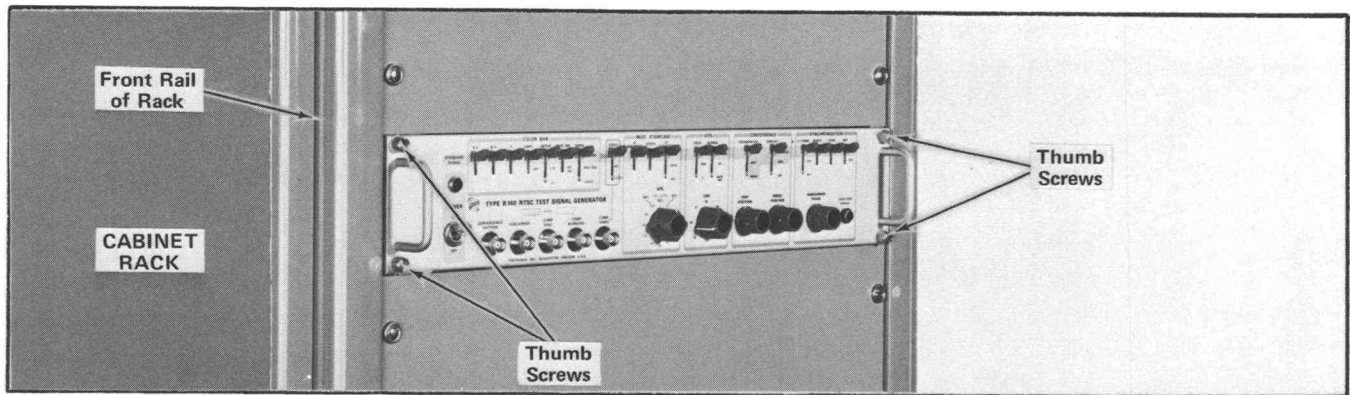


Fig. 6-1. The Type R140 installed in a cabinet type rack.

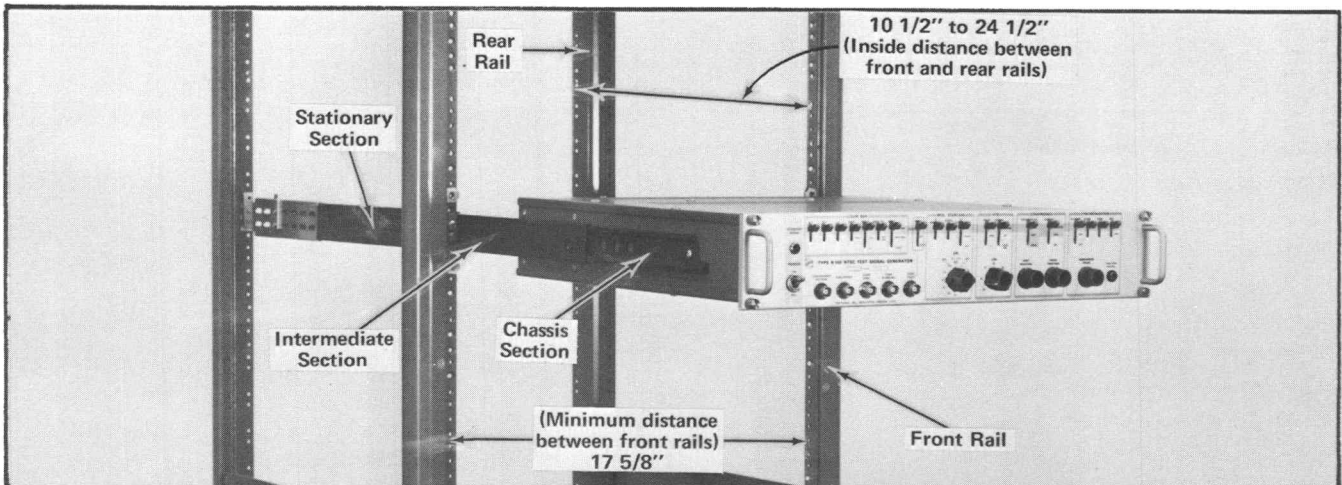


Fig. 6-2. The Type R140 shown in the fully extended position. The cabinet rack sides have been removed from the rack to show mounting.

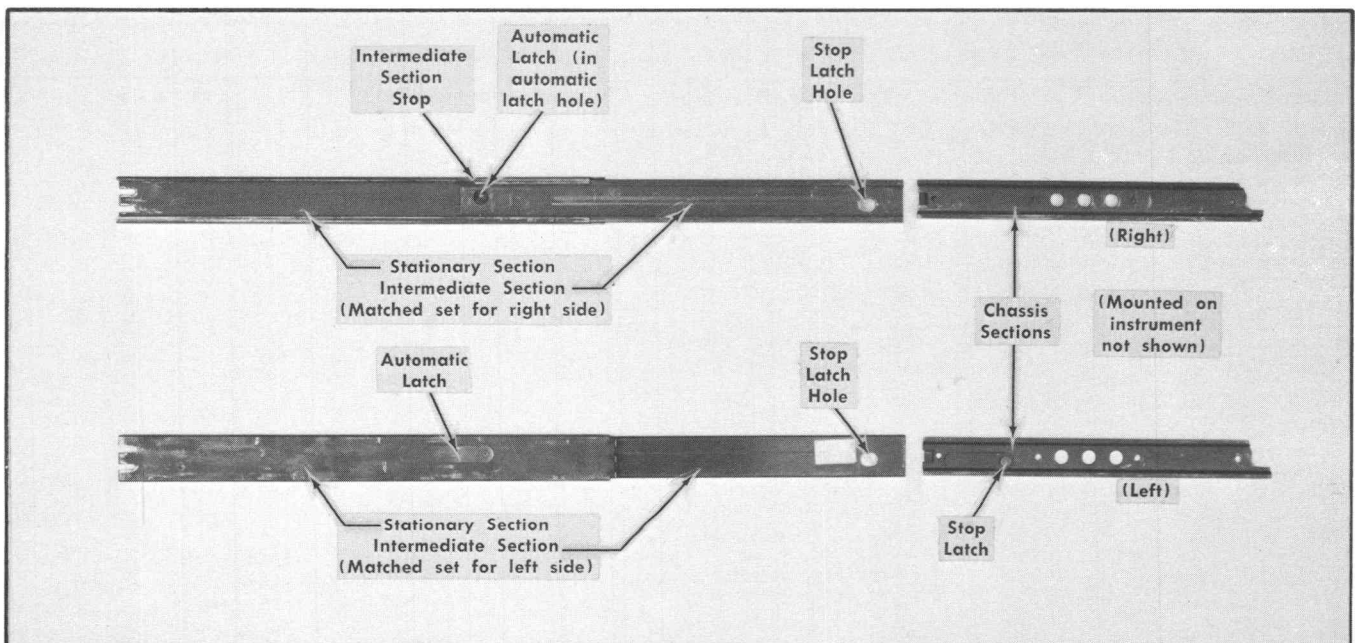


Fig. 6-3. Illustration showing the 1 3/4-inch wide slide-out track assemblies.

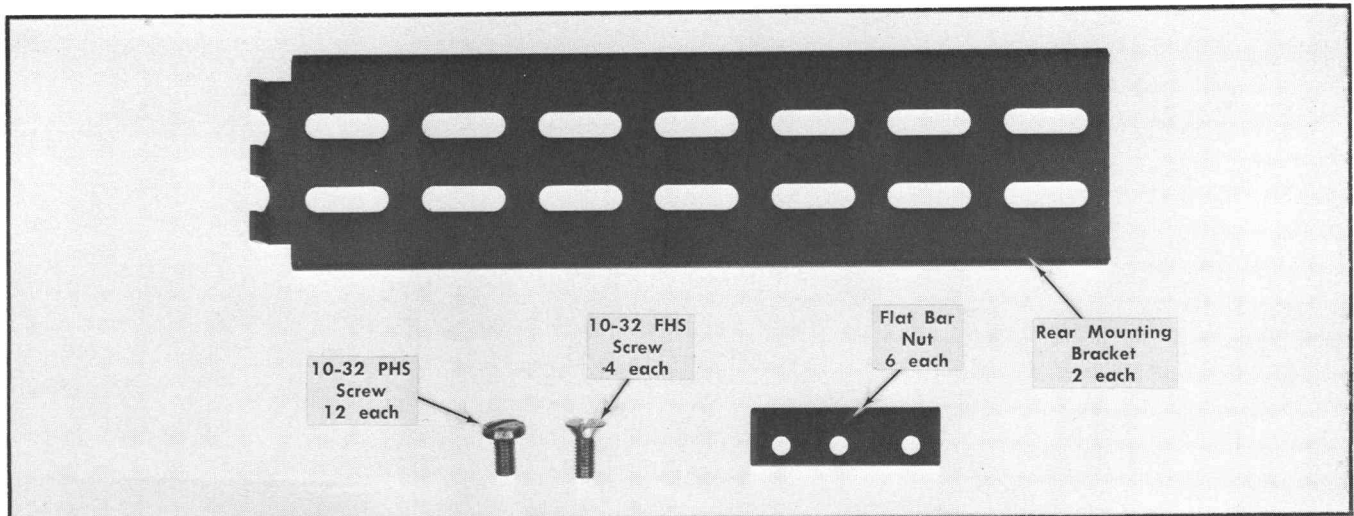


Fig. 6-4. Small hardware components for mounting the stationary sections to the rack rails.

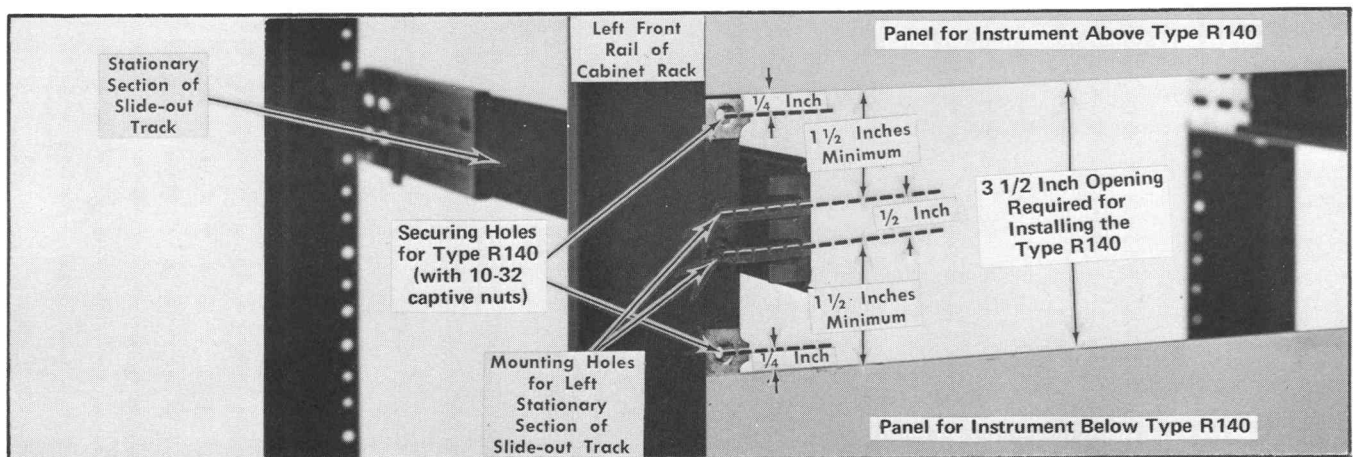


Fig. 6-5. Vertical mounting position of the left stationary section and location of the securing holes. These same dimensions apply to the right front rail.

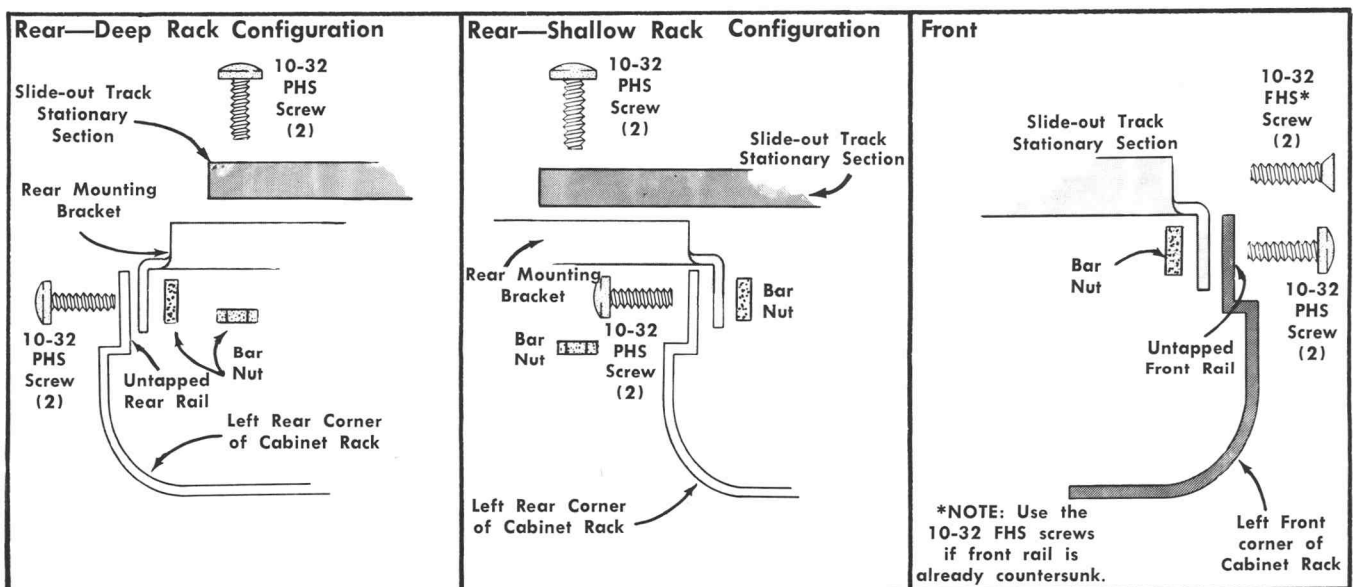


Fig. 6-6. Top view of cabinet rack showing mounting position of the left stationary section to the rails of the rack. Since the rails are not tapped, bar nuts are used to mount the stationary section to the rack rails.

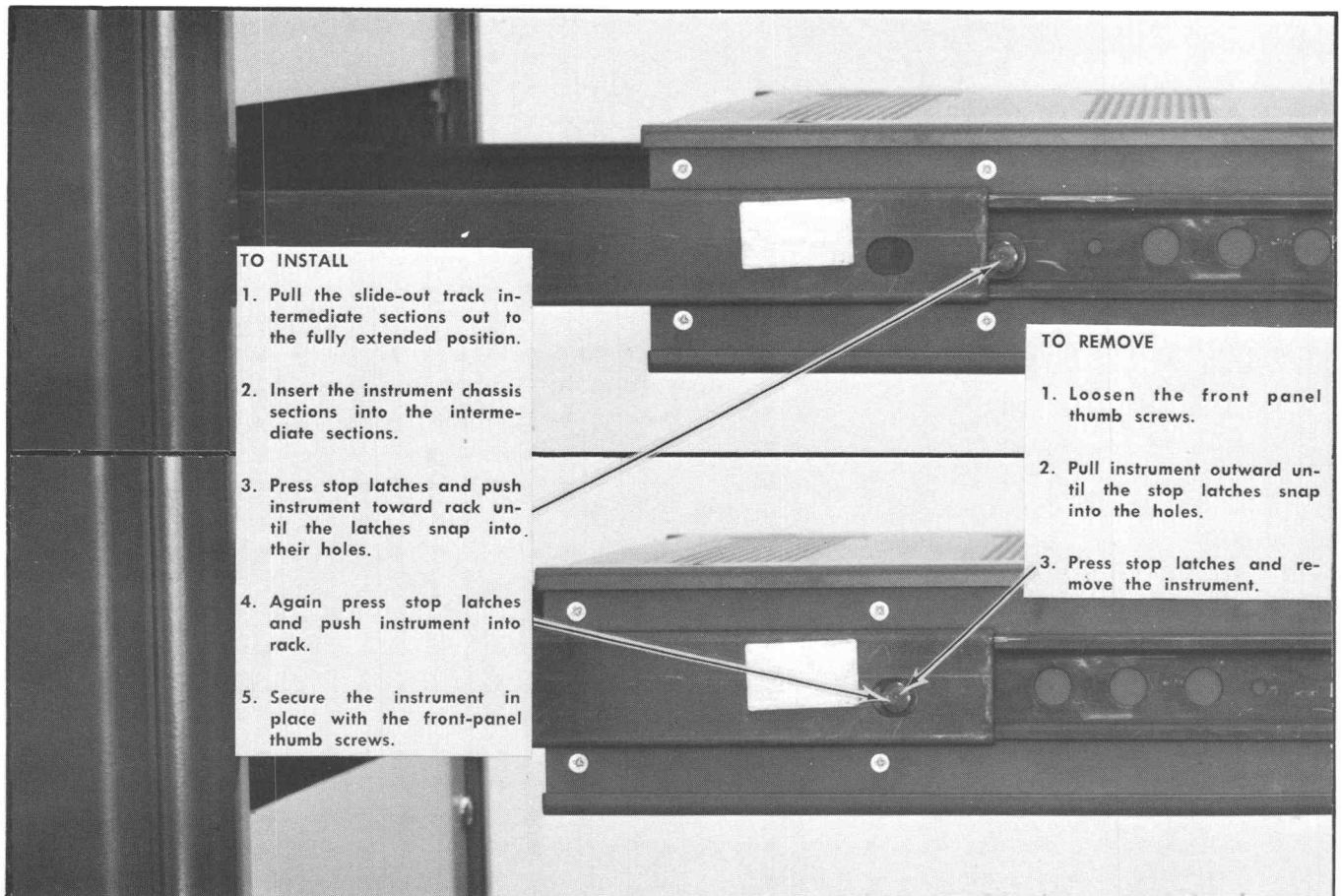


Fig. 6-7. Installing and removing the instrument.

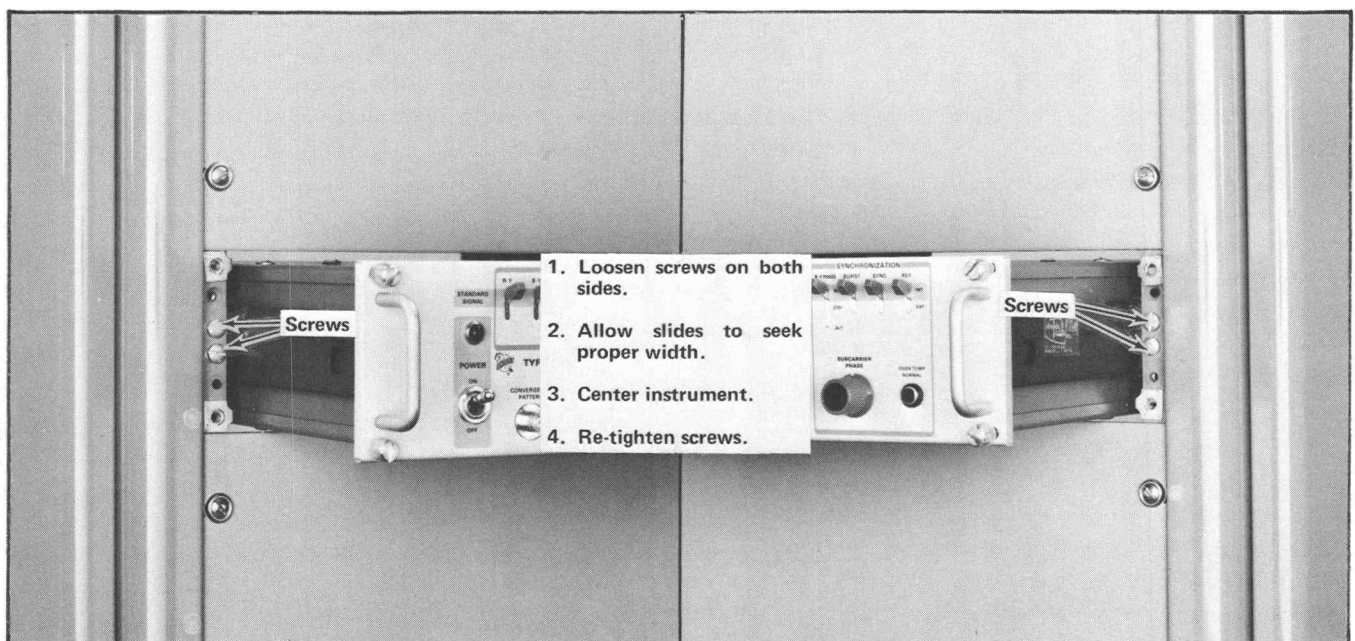
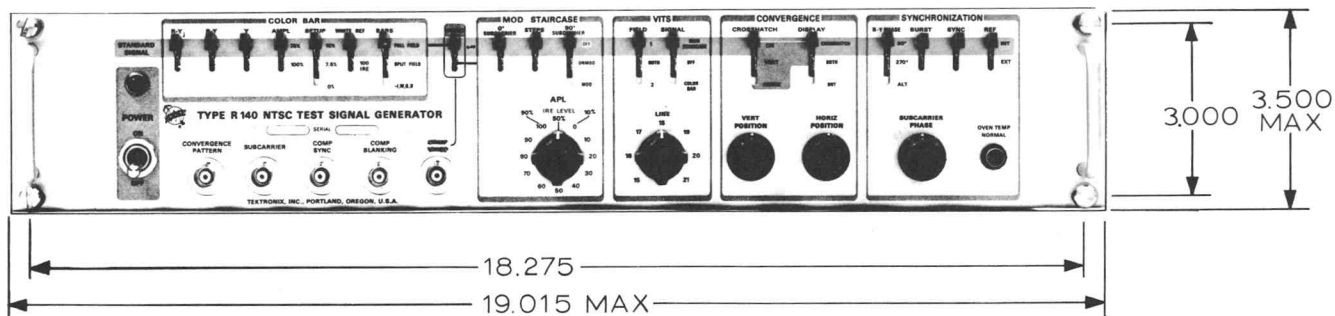
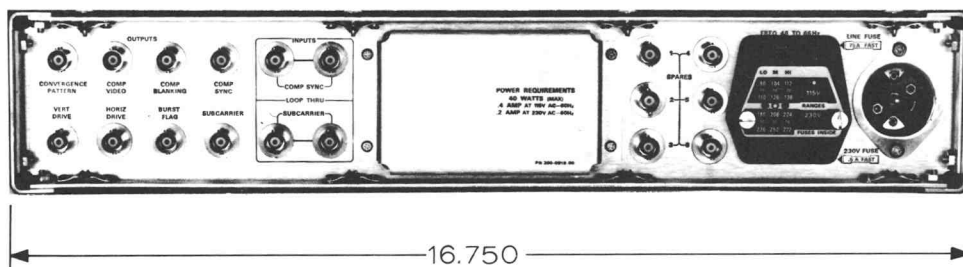
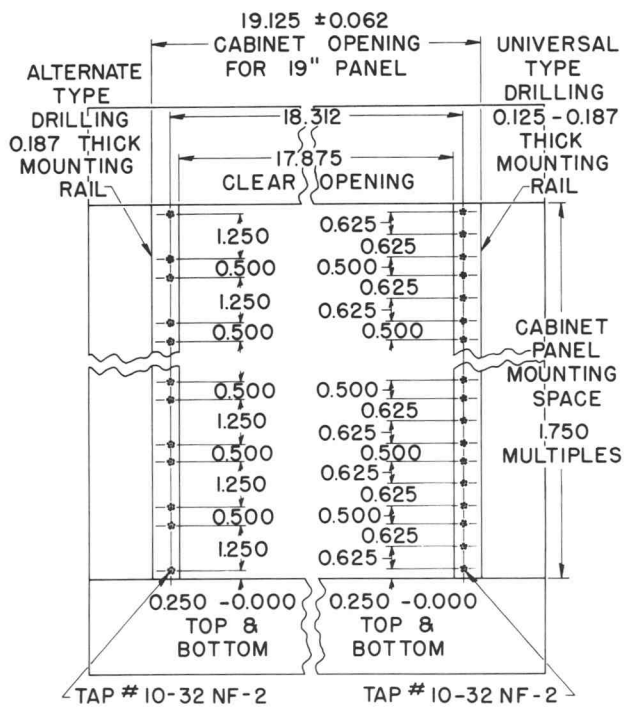
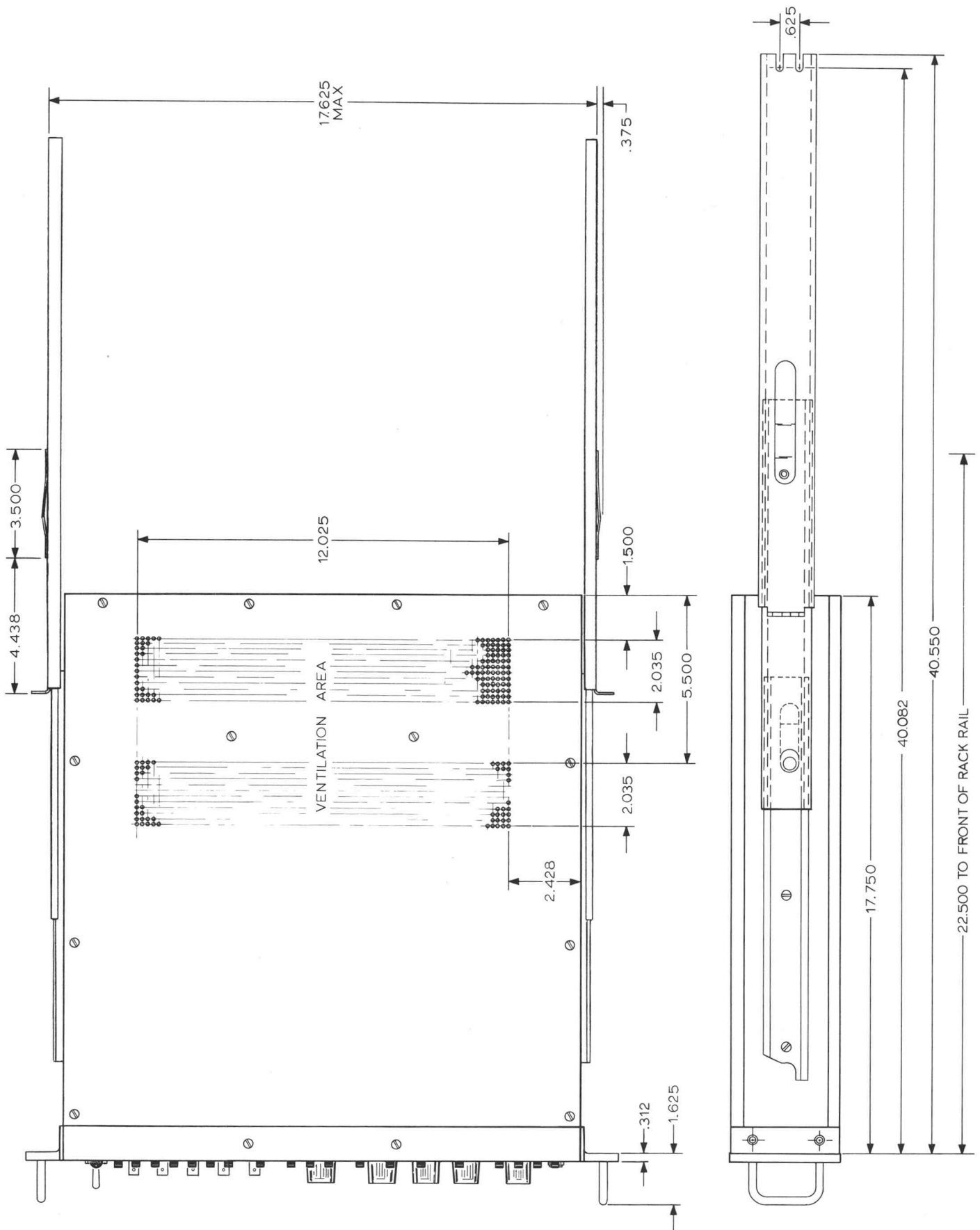


Fig. 6-8. Adjusting the slide-out tracks for smooth sliding action.

RACK RAIL TYPES





Dimensional Drawing

PARTS LIST ABBREVIATIONS

BHB	binding head brass	int	internal
BHS	binding head steel	lg	length or long
cap.	capacitor	met.	metal
cer	ceramic	mtg hdw	mounting hardware
comp	composition	OD	outside diameter
conn	connector	OHB	oval head brass
CRT	cathode-ray tube	OHS	oval head steel
csk	countersunk	P/O	part of
DE	double end	PHB	pan head brass
dia	diameter	PHS	pan head steel
div	division	plstc	plastic
elect.	electrolytic	PMC	paper, metal cased
EMC	electrolytic, metal cased	poly	polystyrene
EMT	electrolytic, metal tubular	prec	precision
ext	external	PT	paper, tubular
F & I	focus and intensity	PTM	paper or plastic, tubular, molded
FHB	flat head brass	RHB	round head brass
FHS	flat head steel	RHS	round head steel
Fil HB	fillister head brass	SE	single end
Fil HS	fillister head steel	SN or S/N	serial number
h	height or high	S or SW	switch
hex.	hexagonal	TC	temperature compensated
HHB	hex head brass	THB	truss head brass
HHS	hex head steel	thk	thick
HSB	hex socket brass	THS	truss head steel
HSS	hex socket steel	tub.	tubular
ID	inside diameter	var	variable
inc	incandescent	w	wide or width
		WW	wire-wound

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

×000	Part first added at this serial number
00×	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.

INDEX OF ELECTRICAL PARTS LIST

Title	Page No.
CHASSIS	7-1
MODULATOR Circuit Board Assembly	7-4
BAR TIMING Circuit Board Assembly	7-8
FIELD TIMING Circuit Board Assembly	7-11
BAR DRIVE & VIDEO OUT Circuit Board Assmbly	7-14
STAIRCASE Circuit Board Assembly	7-20
LINE TIMING Circuit Board Assembly	7-23
CROSS HATCH Circuit Board Assembly	7-29
OUTPUT AMP Circuit Board Assembly	7-33
SUBCARRIER OUTPUT Circuit Board Assembly	7-37
SUBCARRIER OSC Circuit Board Assembly	7-39
POWER SUPPLY Circuit Board Assembly	7-40

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SECTION 7

ELECTRICAL PARTS LIST

Values are fixed, unless marked Variable.

Kct. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description		
CHASSIS						
Bulbs						
DS42	150-0018-00			Incandescent	6.3 V #12	
DS88	150-0065-00			Incandescent	10 V	4 mA green lens
Capacitors						
Tolerance $\pm 20\%$ unless otherwise indicated.						
C11	290-0334-00			1250 μF	Elect.	50 V +75% — 10%
C42	290-0321-00			11,000 μF	Elect.	15 V +100% — 10%
C61	290-0086-00			2000 μF	Elect.	30 V
C92 ¹						
C94 ¹						
C98 ¹						
C1157	281-0613-00	XB030000		10 pF	Cer	200 V 10%
Fuses						
F2	159-0042-00			$\frac{3}{4}$ A 3 AG	Fast-Blo	
F3	159-0025-00			$\frac{1}{2}$ A 3 AG	Fast-Blo	
Filter						
FL4	119-0095-04			2 x 1 A, 275 VAC, 400 Hz		
Connectors						
J40	131-0126-00			BNC, single contact		
J42	131-0126-00			BNC, single contact		
J60	131-0126-00			BNC, single contact		
J62	131-0126-00			BNC, single contact		
J64	131-0126-00			BNC, single contact		

¹Furnished as a unit with Goniometer (*119-0133-00).

CHASSIS (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Connectors (cont)				
J66	131-0126-00			BNC, single contact
J70	131-0126-00			BNC, single contact
J72	131-0126-00			BNC, single contact
J74	131-0126-00			BNC, single contact
J76	131-0126-00			BNC, single contact
J80	131-0126-00			BNC, single contact
J82	131-0126-00			BNC, single contact
J84	131-0126-00			BNC, single contact
J86	131-0126-00			BNC, single contact
J88	131-0126-00			BNC, single contact
J90	131-0126-00			BNC, single contact
J92	131-0126-00			BNC, single contact

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R50	321-0329-00		26.1 k Ω	$\frac{1}{8}$ W	Prec	1%
R51	321-0283-00		8.66 k Ω	$\frac{1}{8}$ W	Prec	1%
R52	321-0254-00		4.32 k Ω	$\frac{1}{8}$ W	Prec	1%
R53	321-0233-00		2.61 k Ω	$\frac{1}{8}$ W	Prec	1%
R54	321-0216-00		1.74 k Ω	$\frac{1}{8}$ W	Prec	1%
R55	321-0202-00		1.24 k Ω	$\frac{1}{8}$ W	Prec	1%
R56	321-0190-00		931 Ω	$\frac{1}{8}$ W	Prec	1%
R57	321-0180-00		732 Ω	$\frac{1}{8}$ W	Prec	1%
R58	321-0170-00		576 Ω	$\frac{1}{8}$ W	Prec	1%
R60	311-0141-00		2 k Ω , Var			
R62	311-0141-00		2 k Ω , Var			
R64	315-0153-00		15 k Ω	$\frac{1}{4}$ W		5%
R66	315-0153-00		15 k Ω	$\frac{1}{4}$ W		5%
R94 ²						
R98 ²						
R1131 ³						
R1134 ³						
R1135 ³						
R1136 ³						
R1137 ³						
R1157	315-0272-00	XB030000	2.7 k Ω	$\frac{1}{4}$ W		5%

²Furnished as a unit with Goniometer (*119-0133-00).³Furnished as a unit with Partial Oven Assembly (*205-0108-01).

CHASSIS (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
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Switches

Wired or Unwired

S2 ⁴			
S3 ⁴			
S4	260-0276-00	Toggle	POWER
S10	260-0621-00	Lever	R-Y PHASE
S12	260-0664-00	Lever	AMPL
S14	260-0621-00	Lever	SET UP
S16	260-0621-00	Lever	FIELD
S18	260-1087-00	Rotary	LINE
S20B ⁵			APL
S22	260-0621-00	Lever	BARS
S24	260-0621-00	Lever	SIGNAL
S26	260-0621-00	Lever	VIDEO
S30	260-0731-00	Lever	BURST
S32	260-0731-00	Lever	B-Y
S34	260-0731-00	Lever	R-Y
S36	260-0731-00	Lever	Y
S38	260-0731-00	Lever	WHITE REF
S44	260-0621-00	Lever	90° SUBARRIER
S46	260-0731-00	Lever	SUBCARRIER
S48	260-0664-00	Lever	STEPS
S50	260-0731-00	Lever	SYNC
S54	260-1088-00	Rotary	APL/IRE LEVEL
S56	260-0731-00	Lever	REF
S62	260-0621-00	Lever	DISPLAY
S64	260-0621-00	Lever	CROSS HATCH
S1131 ⁶			

Transistors

Q35	*151-0140-00	Silicon	Selected from 2N3055
Q55	*151-0140-00	Silicon	Selected from 2N3055
Q85	*151-0148-00	Silicon	Selected from 40250 RCA
Q1131 ⁶			

Transformers

T1	*120-0630-00	L. V. Power
T95 ⁷		

⁴See Mechanical Parts List. Line Voltage Selector Body.⁵Furnished as a unit with S54.⁶Furnished as a unit with Partial Oven Assembly (*205-0108-01).⁷Furnished as a unit with Goniometer (*119-0133-00).

MODULATOR Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
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*670-0301-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C104	283-0004-00			0.02 μ F	Cer	150 V	
C105	283-0047-00			270 pF	Cer	500 V	5%
C106	283-0047-00			270 pF	Cer	500 V	5%
C114	283-0004-00			0.02 μ F	Cer	150 V	
C115	283-0047-00			270 pF	Cer	500 V	5%
C116	283-0047-00			270 pF	Cer	500 V	5%
C117	283-0047-00			270 pF	Cer	500 V	5%
C118	283-0047-00			270 pF	Cer	500 V	5%
C119	290-0134-00			22 μ F	Elect.	15 V	
C120	290-0134-00			22 μ F	Elect.	15 V	
C121	290-0134-00			22 μ F	Elect.	15 V	
C124	283-0004-00			0.02 μ F	Cer	150 V	
C125	283-0598-00			253 pF	Mica	300 V	5%
C127	283-0598-00			253 pF	Mica	300 V	5%
C128	283-0004-00			0.02 μ F	Cer	150 V	
C129	290-0134-00			22 μ F	Elect.	15 V	
C133	281-0116-00			1.6-9.1 pF, Var	Air		
C143	290-0134-00			22 μ F	Elect.	15 V	
C152	281-0116-00			1.6-9.1 pF, Var	Air		
C157	281-0116-00			1.6-9.1 pF, Var	Air		
C162	283-0603-00			113 pF	Mica	300 V	2%
C167	283-0596-00			528 pF	Mica	300 V	1%
C168	283-0603-00			113 pF	Mica	300 V	2%
C173	283-0596-00			528 pF	Mica	300 V	1%
C176	283-0643-00	B010100	B029999	0.02 μ F	Cer	300 V	± 0.5 pF
C176	283-0642-00	B030000		33 pF	Mica	300 V	± 0.5 pF
C177	283-0004-00			22 pF	Mica	150 V	
C182	283-0603-00			113 pF	Mica	300 V	2%
C183	283-0004-00			0.02 μ F	Cer	150 V	
C184	283-0638-00	B010100	B029999	130 pF	Mica	100 V	1%
C184	283-0633-00	B030000		77 pF	Mica	100 V	1%
C187	283-0596-00			528 pF	Mica	300 V	1%
C188	283-0603-00			113 pF	Mica	300 V	2%
C193	283-0596-00			528 pF	Mica	300 V	1%

Semiconductor Device, Diodes

CR104	*152-0185-00		Silicon	Replaceable by 1N4152
CR105	*152-0185-00		Silicon	Replaceable by 1N4152

MODULATOR Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Inductors				
L126	*114-0278-00		4.6-16.7 μ H	Core 276-0568-00
L163	*114-0280-00		12-43 μ H, Var	Core 276-0568-00
L167	*114-0280-00		12-43 μ H, Var	Core 276-0568-00
L176	*114-0281-00		35-70 μ H, Var	Core 276-0540-00
L183	*114-0280-00		12-43 μ H, Var	Core 276-0568-00
L184	*114-0281-00		35-70 μ H, Var	Core 276-0540-00
L187	*114-0280-00		12-43 μ H, Var	Core 276-0568-00
Transistors				
Q111	151-0225-00		Silicon	2N3563
Q112	151-0225-00		Silicon	2N3563
Q113	151-0190-00		Silicon	2N3904
Q114	151-0190-00		Silicon	2N3904
Q115	151-0190-00		Silicon	2N3904
Q116	151-0190-00		Silicon	2N3904
Q117	151-0190-00		Silicon	2N3904
Q118	151-0190-00		Silicon	2N3904
Q122	151-0225-00		Silicon	2N3563
Q123	151-0225-00		Silicon	2N3563
Q145 ⁸	*153-0577-00		Silicon	Tek Spec
Q146 ⁹	*153-0577-00		Silicon	Tek Spec
Q153	151-0232-00		Silicon	Dual
Q155 ⁸	*153-0577-00		Silicon	Tek Spec
Q156 ⁹	*153-0577-00		Silicon	Tek Spec
Q157	151-0232-00		Silicon	Dual
Q165 ⁸	*153-0577-00		Silicon	Tek Spec
Q166 ⁹	*153-0577-00		Silicon	Tek Spec
Q172	*151-0195-00		Silicon	Replaceable by MPS 6515
Q173	*151-0195-00		Silicon	Replaceable by MPS 6515
Q175 ⁸	*153-0577-00		Silicon	Tek Spec
Q176 ⁹	*153-0577-00		Silicon	Tek Spec
Q177	*151-0195-00		Silicon	Replaceable by MPS 6515
Q178	*151-0195-00		Silicon	Replaceable by MPS 6515

⁸Q145, Q155, Q165 and Q175 furnished as a matched set.⁹Q146, Q156, Q166 and Q176 furnished as a matched set.

MODULATOR Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description	
Resistors				
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.				
R100	315-0100-00	10 Ω	$\frac{1}{4}$ W	5%
R101	315-0100-00	10 Ω	$\frac{1}{4}$ W	5%
R102	315-0182-00	1.8 k Ω	$\frac{1}{4}$ W	5%
R103	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R104	315-0752-00	7.5 k Ω	$\frac{1}{4}$ W	5%
R105	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R106	315-0362-00	3.6 k Ω	$\frac{1}{4}$ W	5%
R107	315-0302-00	3 k Ω	$\frac{1}{4}$ W	5%
R108	315-0202-00	2 k Ω	$\frac{1}{4}$ W	5%
R109	315-0100-00	10 Ω	$\frac{1}{4}$ W	5%
R110	315-0100-00	10 Ω	$\frac{1}{4}$ W	5%
R111	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W	5%
R112	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R114	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W	5%
R115	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R116	315-0362-00	3.6 k Ω	$\frac{1}{4}$ W	5%
R117	315-0101-00	100 Ω	$\frac{1}{4}$ W	5%
R118	301-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R119	315-0202-00	2 k Ω	$\frac{1}{4}$ W	5%
R120	315-0100-00	10 Ω	$\frac{1}{4}$ W	5%
R123	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R124	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R126	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R127	315-0181-00	180 Ω	$\frac{1}{4}$ W	5%
R128	321-0122-00	182 Ω	$\frac{1}{8}$ W Prec	1%
R129	315-0101-00	100 Ω	$\frac{1}{4}$ W	5%
R130	321-0159-00	442 Ω	$\frac{1}{8}$ W Prec	1%
R131	321-0122-00	182 Ω	$\frac{1}{8}$ W Prec	1%
R132	321-0154-00	392 Ω	$\frac{1}{8}$ W Prec	1%
R133	321-0154-00	392 Ω	$\frac{1}{8}$ W Prec	1%
R134	315-0302-00	3 k Ω	$\frac{1}{4}$ W	5%
R135	315-0302-00	3 k Ω	$\frac{1}{4}$ W	5%
R136	321-0154-00	392 Ω	$\frac{1}{8}$ W Prec	1%
R137	321-0154-00	392 Ω	$\frac{1}{8}$ W Prec	1%
R138	321-0159-00	442 Ω	$\frac{1}{8}$ W Prec	1%
R141	321-0812-07	455 Ω	$\frac{1}{8}$ W Prec	1/10%
R142	311-0886-00	50 Ω , Var		
R143	315-0202-00	2 k Ω	$\frac{1}{4}$ W	5%
R144	321-0812-07	455 Ω	$\frac{1}{8}$ W Prec	1/10%
R145	315-0181-00	180 Ω	$\frac{1}{4}$ W	5%

MODULATOR Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R146	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R147	315-0202-00		2 k Ω	$\frac{1}{4}$ W		5%
R148	311-0886-00		50 k Ω , Var			
R151	321-0735-07		1.001 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R152	321-0735-07		1.001 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R155	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R156	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R157	321-0812-07		455 Ω	$\frac{1}{8}$ W	Prec	1/10%
R158	321-0735-07		1.001 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R161	321-0335-00		301 k Ω	$\frac{1}{8}$ W	Prec	1%
R162	321-0143-00		301 k Ω	$\frac{1}{8}$ W	Prec	1%
R165	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R166	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R167	321-0812-07		455 Ω	$\frac{1}{8}$ W	Prec	1/10%
R168	321-0735-07		1.001 k Ω	$\frac{1}{8}$ W	Prec	1/10%
R169	321-0143-00		301 Ω	$\frac{1}{8}$ W	Prec	1%
R174	321-0210-00	B010100	1.5 k Ω	$\frac{1}{8}$ W	Prec	1%
R174	321-0193-00	B030000	1 k Ω	$\frac{1}{8}$ W	Prec	1%
R175	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R176	315-0181-00		180 Ω	$\frac{1}{4}$ W		5%
R177	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R178	321-0335-00		30.1 k Ω	$\frac{1}{8}$ W	Prec	1%
R179	321-0335-00		30.1 k Ω	$\frac{1}{8}$ W	Prec	1%
R182	321-0143-00		301 Ω	$\frac{1}{8}$ W	Prec	1%
R183	321-0335-00		30.1 k Ω	$\frac{1}{8}$ W	Prec	1%
R186	315-0302-00		3 k Ω	$\frac{1}{4}$ W		5%
R188	321-0143-00		301 Ω	$\frac{1}{8}$ W	Prec	1%
R193	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R194	315-0302-00		3 k Ω	$\frac{1}{4}$ W		5%

Transformers

T127	*120-0631-00		Toroid, 10 turns trifilar
T136	*120-0584-00		Toroid, three 10 turn windings
T144	*120-0587-00		Toroid, four 10 turn windings
T174	*120-0524-00		Toroid, 12 turns quadfilar

Integrated Circuit

U102	156-0012-00		Clocked J-K Flipflop.	Replaceable by Fairchild μ L923
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BAR TIMING Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
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*670-0302-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C207	281-0022-00		8-50 pF, Var	Cer		
C208	283-0600-00		43 pF	Mica	500 V	5%
C209	290-0134-00		22 μ F	Elect.	15 V	
C212	283-0080-00		0.022 μ F	Cer	25 V	+ 80%—20%
C215	283-0047-00		270 pF	Cer	500 V	5%
C216	283-0026-00		0.2 μ F	Cer	25 V	
C218	283-0641-00		180 pF	Mica	100 V	1%
C223	283-0026-00		0.2 μ F	Cer	25 V	
C224	281-0638-00		240 pF	Cer	500 V	5%
C227	281-0022-00		8-50 pF, Var	Cer		
C231	283-0026-00		0.2 μ F	Cer	25 V	
C252	283-0598-00		253 pF	Mica	300 V	5%

Semiconductor Device, Diodes

CR202	*152-0185-00		Silicon	Replaceable by 1N4152
CR206	*152-0185-00		Silicon	Replaceable by 1N4152
CR251	*152-0185-00		Silicon	Replaceable by 1N4152
CR261	*152-0185-00		Silicon	Replaceable by 1N4152
CR271	*152-0185-00		Silicon	Replaceable by 1N4152
CR281	*152-0185-00		Silicon	Replaceable by 1N4152

Inductor

L217	114-0177-00		280-650 μ H, Var	Core 276-0506-00
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Transistors

Q203	*151-0219-00		Silicon	Replaceable by 2N4250
Q206	151-0224-00		Silicon	2N3692
Q208	151-0225-00		Silicon	2N3563
Q213	151-0190-00	B010100	Silicon	2N3904
Q213	151-0224-00	B040000	Silicon	2N3692
Q216	151-0220-00		Silicon	2N4122

BAR TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description		
Transistors (cont)						
Q218	*151-0198-00	B010100	B039999	Silicon	Replaceable by MPS 918	
Q218	*151-0127-00	B040000		Silicon	Selected from 2N2369	
Q221	151-0220-00			Silicon	2N4122	
Q223	*151-0219-00			Silicon	Replaceable by 2N4250	
Q226	151-0225-00			Silicon	2N3563	
Q228	151-0225-00			Silicon	2N3563	
Q233	*151-0219-00			Silicon	Replaceable by 2N4250	
Q236	151-0220-00			Silicon	2N4122	
Q237	151-0225-00			Silicon	2N3563	
Q238	*151-0198-00			Silicon	Replaceable by MPS 918	
Q251	151-0224-00			Silicon	2N3692	
Q252	151-0224-00			Silicon	2N3692	
Q261	*151-0192-00			Silicon	Replaceable by MPS 6521	
Q262	*151-0192-00			Silicon	Replaceable by MPS 6521	
Q281	151-0224-00			Silicon	2N3692	
Q282	151-0224-00			Silicon	2N3692	
Q291	*151-0192-00			Silicon	Replaceable by MPS 6521	
Q292	*151-0192-00			Silicon	Replaceable by MPS 6521	

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R201	321-0126-00	200 Ω	$\frac{1}{8}$ W	Prec	1%
R202	321-0168-00	549 Ω	$\frac{1}{8}$ W	Prec	1%
R203	315-0470-00	47 Ω	$\frac{1}{4}$ W		5%
R204	315-0273-00	27 k Ω	$\frac{1}{4}$ W		5%
R205	315-0103-00	10 k Ω	$\frac{1}{4}$ W		5%
R206	315-0681-00	680 Ω	$\frac{1}{4}$ W		5%
R207	315-0470-00	47 Ω	$\frac{1}{4}$ W		5%
R208	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W		5%
R213	321-0259-00	4.87 k Ω	$\frac{1}{8}$ W	Prec	1%
R214	321-0213-00	1.62 k Ω	$\frac{1}{8}$ W	Prec	1%
R215	321-0130-00	221 Ω	$\frac{1}{8}$ W	Prec	1%
R216	315-0202-00	2 k Ω	$\frac{1}{4}$ W		5%
R217	315-0470-00	47 Ω	$\frac{1}{4}$ W		5%
R218	315-0681-00	680 Ω	$\frac{1}{4}$ W		5%
R219	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W		5%
R221	315-0102-00	1 k Ω	$\frac{1}{4}$ W		5%
R222	315-0163-00	16 k Ω	$\frac{1}{4}$ W		5%
R223	315-0473-00	47 k Ω	$\frac{1}{4}$ W		5%
R224	315-0102-00	1 k Ω	$\frac{1}{4}$ W		5%
R225	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W		5%

BAR TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Resistors (cont)			
R226	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W 5%
R227	315-0681-00	680 Ω	$\frac{1}{4}$ W 5%
R231	311-0950-00	10 k Ω , Var	
R233	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R234	315-0471-00	470 Ω	$\frac{1}{4}$ W 5%
R235	311-0953-00	2.5 k Ω , Var	
R236	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R237	315-0132-00	1.3 k Ω	$\frac{1}{4}$ W 5%
R238	321-0193-00	1 k Ω	$\frac{1}{8}$ W Prec 1%
R239	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R241	321-0359-00	53.6 k Ω	$\frac{1}{8}$ W Prec 1%
R252	311-0836-00	5 k Ω , Var	
R253	321-0342-00	35.7 k Ω	$\frac{1}{8}$ W Prec 1%
R254	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R261	315-0101-00	100 Ω	$\frac{1}{4}$ W 5%
R262	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R263	315-0101-00	100 Ω	$\frac{1}{4}$ W 5%
R271	311-0836-00	5 k Ω , Var	
R272	311-0950-00	10 k Ω , Var	
R273	321-0342-00	35.7 k Ω	$\frac{1}{8}$ W Prec 1%
R281	321-0359-00	53.6 k Ω	$\frac{1}{8}$ W Prec 1%
R291	315-0101-00	100 Ω	$\frac{1}{4}$ W 5%
R292	315-0471-00	470 Ω	$\frac{1}{4}$ W 5%

Integrated Circuits

U243	156-0012-00	Clocked J-K Flipflop Replaceable by Fairchild μ L923
U245	156-0012-00	Clocked J-K Flipflop Replaceable by Fairchild μ L923
U247	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U248	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U253	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U255	156-0012-00	Clocked J-K Flipflop Replaceable by Fairchild μ L923
U257	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U258	156-0012-00	Clocked by J-K Flipflop Replaceable by Fairchild μ L923
U263	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U265	156-0012-00	Clocked J-K Flipflop Replaceable by Fairchild μ L923

BAR TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Integrated Circuits (cont)			
U267	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U268	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U273	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U275	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U277	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U278	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L 923
U293	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U295	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U297	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U298	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914

FIELD TIMING Circuit Board Assembly

*670-0303-00

Complete Board

CapacitorsTolerance $\pm 20\%$ unless otherwise indicated.

C338	283-0032-00	470 pF	Cer	500 V	5%
C366	283-0032-00	470 pF	Cer	500 V	5%
C368	283-0104-00	2000 pF	Cer	500 V	5%
C372	283-0032-00	470 pF	Cer	500 V	5%

Transistors

Q311	151-0224-00	Silicon	2N3692
Q312	151-0224-00	Silicon	2N3692
Q314	151-0224-00	Silicon	2N3692
Q316	151-0224-00	Silicon	2N3692
Q317	151-0224-00	Silicon	2N3692
Q318	151-0224-00	Silicon	2N3692
Q319	151-0224-00	Silicon	2N3692
Q333	151-0207-00	Silicon	2N3415
Q381	151-0207-00	Silicon	2N3415
Q384	151-0207-00	Silicon	2N3415

FIELD TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Transistors (cont)			
Q385	151-0207-00	Silicon	2N3415
Q387	151-0207-00	Silicon	2N3415
Q388	151-0207-00	Silicon	2N3415
Q394	151-0207-00	Silicon	2N3415
Q397	151-0207-00	Silicon	2N3415
Q398	151-0207-00	Silicon	2N3415
Resistors			
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.			
R311	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R312	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R314	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R316	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R317	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R318	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R319	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R332	315-0182-00	1.8 k Ω	$\frac{1}{4}$ W 5%
R333	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R338	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R339	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R361	315-0561-00	560 Ω	$\frac{1}{4}$ W 5%
R365	315-0243-00	24 k Ω	$\frac{1}{4}$ W 5%
R366	315-0202-00	2 k Ω	$\frac{1}{4}$ W 5%
R367	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R368	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R369	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R372	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R374	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R391	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W 5%
R392	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R394	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R396	315-0751-00	750 Ω	$\frac{1}{4}$ W 5%
R397	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%
R398	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W 5%
R399	315-0102-00	1 k Ω	$\frac{1}{4}$ W 5%

FIELD TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Integrated Circuits			
U301	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U302	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U304	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U306	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L 914
U308	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U309	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U321	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U322	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U324	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U326	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U328	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U329	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U334	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U336	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U338	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U341	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L 914
U342	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U344	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U346	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U348	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U349	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U361	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U362	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U364	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U366	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914

FIELD TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Integrated Circuits (cont)			
U368	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U369	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U371	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U372	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U374	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U376	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U378	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U379	156-0012-00		Clocked J-K Flipflop Replaceable by Fairchild μ L923
U391	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U392	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U396	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U399	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914

BAR DRIVE & VIDEO OUT Circuit Board Assembly

*670-0304-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C401	281-0650-00	18 pF	Cer	200 V	10%
C406	281-0613-00	10 pF	Cer	200 V	10%
C407	281-0613-00	10 pF	Cer	200 V	10%
C410	281-0616-00	6.8 pF	Cer	200 V	
C422	281-0022-00	8-50 pF, Var	Cer		
C427	281-0022-00	8-50 pF, Var	Cer		
C430	283-0080-00	0.022 μ F	Cer	25 V	+80%—20%
C431	283-0080-00	0.022 μ F	Cer	25 V	+80%—20%
C445	281-0650-00	18 pF	Cer	200 V	10%
C451	283-0596-00	528 pF	Mica	300 V	1%

BAR DRIVE & VIDEO OUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description		
Capacitors (cont)						
C452	283-0051-00		0.0033 μ F	Cer	100 V	5%
C455	283-0643-00		22 pF	Mica	300 V	± 0.5 pF
C456	283-0602-00		53 pF	Mica	300 V	5%
C458	283-0594-00		0.001 μ F	Mica	100 V	1%
C459	283-0634-00		65 pF	Mica	100 V	1%
C463	281-0616-00		6.8 pF	Cer	200 V	
C465	283-0636-00		36 pF	Mica	100 V	± 0.5 pF
C467	283-0610-00		220 pF	Mica	500 V	5%
C468	283-0622-00		450 pF	Mica	300 V	1%
C469	283-0640-00		160 pF	Mica	100 V	1%
C471	283-0080-00		0.022 μ F	Cer	25 V	+80% — 20%
C478	283-0632-00		87 pF	Mica	100 V	1%
C479	283-0080-00		0.022 μ F	Cer	25 V	+80% — 20%
C484	283-0003-00		0.01 μ F	Cer	150 V	
C487	283-0003-00		0.01 μ F	Cer	150 V	
C489	283-0059-00		1 μ F	Cer	25 V	+80% — 20%
C491	283-0017-00		1 μ F	Cer	3 V	
C492	283-0026-00		0.2 μ F	Cer	25 V	
C493	283-0026-00		0.2 μ F	Cer	25 V	
C495	290-0134-00		22 μ F	Elect.	15 V	
C496	290-0134-00	B010100	B029999	22 μ F	Elect.	25 V
C496	290-0309-00	B030000		100 μ F	Elect.	25 V

Semiconductor Device, Diodes

CR406	*152-0185-00	Silicon	Replaceable by 1N4152
CR421	*152-0185-00	Silicon	Replaceable by 1N4152
CR422	*152-0185-00	Silicon	Replaceable by 1N4152
CR424	*152-0185-00	Silicon	Replaceable by 1N4152
CR425	*152-0185-00	Silicon	Replaceable by 1N4152
CR426	*152-0185-00	Silicon	Replaceable by 1N4152
CR428	*152-0185-00	Silicon	Replaceable by 1N4152
CR441	*152-0185-00	Silicon	Replaceable by 1N4152
CR442	*152-0185-00	Silicon	Replaceable by 1N4152
CR443	*152-0185-00	Silicon	Replaceable by 1N4152
CR453	*152-0185-00	Silicon	Replaceable by 1N4152
CR460	*152-0185-00	Silicon	Replaceable by 1N4152
CR461	*152-0185-00	Silicon	Replaceable by 1N4152
CR462	*152-0185-00	Silicon	Replaceable by 1N4152
CR463	*152-0185-00	Silicon	Replaceable by 1N4152
CR472	*152-0185-00	Silicon	Replaceable by 1N4152
CR479	*152-0185-00	Silicon	Replaceable by 1N4152

BAR DRIVE & VIDEO OUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
Relay				
K495	*148-0034-00			Armature, dpdt, 15 V DC
Inductors				
L456	*114-0222-00		2-6 μ H, Var	Core 276-0568-00
L458	*114-0278-00		4.6-16.7 μ H, Var	Core 276-0568-00
L466	*114-0222-00		2-6 μ H, Var	Core 276-0568-00
L468	*114-0278-00		4.6-16.7 μ H, Var	Core 276-0568-00
Transistors				
Q400	*151-0192-00		Silicon	Replaceable by MPS 6521
Q402	*151-0192-00		Silicon	Replaceable by MPS 6521
Q403	*151-0192-00		Silicon	Replaceable by MPS 6521
Q404	*151-0192-00		Silicon	Replaceable by MPS 6521
Q406	*151-0192-00		Silicon	Replaceable by MPS 6521
Q407	*151-0192-00		Silicon	Replaceable by MPS 6521
Q408	*151-0192-00		Silicon	Replaceable by MPS 6521
Q420	151-0224-00		Silicon	2N3692
Q422	151-0224-00		Silicon	2N3692
Q423	151-0224-00		Silicon	2N3692
Q424	151-0224-00		Silicon	2N3692
Q426	151-0224-00		Silicon	2N3692
Q427	151-0224-00		Silicon	2N3692
Q428	151-0224-00		Silicon	2N3692
Q430	151-0220-00		Silicon	2N4122
Q431	151-0224-00		Silicon	2N3692
Q433	151-0224-00		Silicon	2N3692
Q434	151-0224-00		Silicon	2N3692
Q435	*151-0192-00		Silicon	Replaceable by MPS 6521
Q436	*151-0192-00		Silicon	Replaceable by MPS 6521
Q437	151-0220-00		Silicon	2N4122
Q441	*151-0192-00		Silicon	Replaceable by MPS 6521
Q443	151-0224-00		Silicon	2N3692
Q445	*151-0192-00		Silicon	Replaceable by MPS 6521
Q446	*151-0192-00		Silicon	Replaceable by MPS 6521
Q447	*151-0192-00		Silicon	Replaceable by MPS 6521
Q450	*151-0192-00		Silicon	Replaceable by MPS 6521
Q451	151-0224-00	B010100	B039999	2N3692
Q451	151-0207-00	B040000		2N3415
Q452	151-0224-00	B010100	B039999	2N3692
Q452	151-0225-00	B040000		2N3563
Q453	151-0224-00	B010100	B039999	2N3692
Q453	151-0225-00	B040000		2N3563

BAR DRIVE & VIDEO OUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
Transistors (cont)				
Q454	151-0224-00		Silicon	2N3692
Q455	*151-0192-00		Silicon	Replaceable by MPS 6521
Q456	*151-0192-00		Silicon	Replaceable by MPS 6521
Q463	151-0224-00		Silicon	2N3692
Q465	*151-0192-00		Silicon	Replaceable by MPS 6521
Q471	*151-0219-00		Silicon	Replaceable by 2N4250
Q473	*151-0192-00		Silicon	Replaceable by MPS 6521
Q474	151-0220-00		Silicon	2N4122
Q475	151-0220-00		Silicon	2N4122
Q476	151-0220-00		Silicon	2N4122
Q477	151-0220-00		Silicon	2N4122
Q478	*151-0192-00		Silicon	Replaceable by MPS 6521
Q481	*151-0219-00		Silicon	Replaceable by 2N4250
Q484	*151-0103-00		Silicon	Replaceable by 2N2219
Q487	*151-0103-00		Silicon	Replaceable by 2N2219
Q491	*151-0192-00		Silicon	Replaceable by MPS 6521

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R400	321-0363-00			59 k Ω	$\frac{1}{8}$ W	Prec	1%
R401	321-0294-00			11.3 k Ω	$\frac{1}{8}$ W	Prec	1%
R402	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%
R403	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%
R404	321-0334-00	B010100	B029999	29.4 k Ω	$\frac{1}{8}$ W	Prec	1%
R404	321-0331-00	B030000		27.4 k Ω	$\frac{1}{8}$ W	Prec	1%
R406	321-0346-00			39.2 k Ω	$\frac{1}{8}$ W	Prec	1%
R407	321-0318-00			20 k Ω	$\frac{1}{8}$ W	Prec	1%
R408	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%
R409	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%
R410	311-0950-00			10 k Ω , Var			
R412	311-0732-00			1 k Ω , Var			
R413	311-0732-00			1 k Ω , Var			
R414	311-0836-00	B010100	B029999	5 k Ω , Var			
R414	311-0840-00	B030000		20 k Ω , Var			
R416	311-0836-00			5 k Ω , Var			
R417	311-0953-00			2.5 k Ω , Var			
R418	321-0299-00			12.7 k Ω	$\frac{1}{8}$ W	Prec	1%
R419	311-0953-00			2.5 k Ω , Var			
R421	315-0102-00			1 k Ω	$\frac{1}{4}$ W		5%
R422	321-0287-00			9.53 k Ω	$\frac{1}{8}$ W	Prec	1%
R423	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%

BAR DRIVE & VIDEO OUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R424	315-0681-00			680 Ω	¼ W	5%
R427	315-0821-00			820 Ω	¼ W	5%
R428	315-0101-00			100 Ω	¼ W	5%
R430	315-0474-00			470 kΩ	¼ W	5%
R431	315-0204-00			200 kΩ	¼ W	5%
R432	315-0151-00			150 Ω	¼ W	5%
R433	311-0704-00			500 Ω, Var		
R434	311-0704-00			500 Ω, Var		
R435	321-0260-00			4.99 kΩ	⅛ W	Prec 1%
R436	315-0101-00			100 Ω	¼ W	5%
R437	321-0294-00			11.3 kΩ	⅛ W	Prec 1%
R438	315-0101-00			100 Ω	¼ W	5%
R439	315-0752-00			7.5 kΩ	¼ W	5%
R441	321-0396-00			130 kΩ	⅛ W	Prec 1%
R442	315-0103-00			10 kΩ	¼ W	5%
R443	311-0953-00			2.5 kΩ, Var		
R444	321-0258-00			4.75 kΩ	⅛ W	Prec 1%
R445	321-0308-00			15.8 kΩ	⅛ W	Prec 1%
R446	321-0294-00			11.3 kΩ	⅛ W	Prec 1%
R447	315-0101-00			100 Ω	¼ W	5%
R448	315-0102-00			1 kΩ	¼ W	5%
R449	315-0102-00			1 kΩ	¼ W	5%
R450	315-0681-00			680 Ω	¼ W	5%
R451	315-0102-00			1 kΩ	¼ W	5%
R452	315-0101-00			100 Ω	¼ W	5%
R453	311-0953-00			2.5 kΩ, Var		
R454	311-0732-00			1 kΩ, Var		
R455	321-0304-00			14.3 kΩ	⅛ W	Prec 1%
R456	315-0101-00			100 Ω	¼ W	5%
R457	321-0105-00	B010100	B039999	121 Ω	⅛ W	Prec 1%
R457	321-0108-00	B040000		130 Ω	⅛ W	Prec 1%
R458	321-0117-00			162 Ω	⅛ W	Prec 1%
R459	321-0172-00			604 Ω	⅛ W	Prec 1%
R460	315-0472-00			4.7 kΩ	¼ W	5%
R461	315-0273-00			27 kΩ	¼ W	5%
R462	315-0561-00			560 Ω	¼ W	5%
R463	311-0836-00	B010100	B029999	5 k, Var		
R463	311-0950-00	B030000		10 kΩ, Var		
R464	321-0352-00	B010100	B029999	45.3 kΩ	⅛ W	Prec 1%
R464	321-0349-00	B030000		42.2 kΩ	⅛ W	Prec 1%
R465	321-0280-00			8.06 kΩ	⅛ W	Prec 1%
R466	321-0210-00			1.5 kΩ	⅛ W	Prec 1%
R467	321-0181-00			750 Ω	⅛ W	Prec 1%

BAR DRIVE & VIDEO OUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
Resistors (cont)							
R468	321-0241-00			3.16 kΩ	1/8 W	Prec	1%
R469	321-0197-00			1.1 kΩ	1/8 W	Prec	1%
R470	315-0473-00			47 kΩ	1/4 W		5%
R471	315-0393-00			39 kΩ	1/4 W		5%
R472	315-0512-00			5.1 kΩ	1/4 W		5%
R473	321-0222-00	B010100	B029999	2 kΩ	1/8 W	Prec	1%
R473	321-0228-00	B030000		2.32 kΩ	1/8 W	Prec	1%
R474	315-0431-00			430 Ω	1/4 W		5%
R475	321-0210-00			1.5 kΩ	1/8 W	Prec	1%
R476	321-0210-00			1.5 kΩ	1/8 W	Prec	1%
R477	315-0431-00			430 Ω	1/4 W		5%
R478	311-0827-00			250 Ω, Var			
R479	321-0228-00			2.32 kΩ	1/8 W	Prec	1%
R480	315-0181-00			180 Ω	1/4 W		5%
R481	321-0193-00	B010100	B029999	1 kΩ	1/8 W	Prec	1%
R481	321-0172-00	B030000		604 Ω	1/8 W	Prec	1%
R482	311-0704-00			500 Ω, Var			
R483	315-0302-00			3 kΩ	1/4 W		5%
R484	321-0231-00			2.49 kΩ	1/8 W	Prec	1%
R485	321-0210-00			1.5 kΩ	1/8 W	Prec	1%
R486	321-0231-00			2.49 kΩ	1/8 W	Prec	1%
R487	321-0085-00			75 Ω	1/8 W	Prec	1%
R488 ¹⁰	*312-0656-00			121 Ω	1/8 W	Prec	1/10%
R489	315-0302-00			3 kΩ	1/4 W		5%
R490	315-0473-00			47 kΩ	1/4 W		5%
R491	315-0393-00			39 kΩ	1/4 W		5%
R492	321-0277-00			7.5 kΩ	1/8 W	Prec	1%
R493	308-0252-00			390 Ω	3 W	WW	5%
R494 } R495 }	*312-0657-00			200 Ω	1/8 W	Prec (matched pair)	
R496	321-0085-00			75 Ω	1/8 W	Prec	1%
R497 ¹¹	*312-0656-00			121 Ω	1/8 W	Prec	1/10%
R498	308-0314-00			680 Ω	3 W	WW	5%
R499	311-0884-00			100 Ω, Var			

¹⁰Matched pair with R497.¹¹Matched pair with R488.

STAIRCASE Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
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*670-0305-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C506	283-0080-00		0.022 μ F	Cer	25 V	+80% -20%
C523	283-0028-00	XB030000	0.0022 μ F	Cer	50 V	
C543	283-0028-00	XB030000	0.0022 μ F	Cer	50 V	
C547	283-0032-00		470 pF	Cer	500 V	5%
C568	290-0296-00		100 μ F	Elect.	20 V	

Semiconductor Device, Diodes

CR510	*152-0185-00	Silicon	Replaceable by 1N4152
CR511	*152-0185-00	Silicon	Replaceable by 1N4152
CR513	*152-0185-00	Silicon	Replaceable by 1N4152
CR514	*152-0185-00	Silicon	Replaceable by 1N4152
CR521	*152-0185-00	Silicon	Replaceable by 1N4152
CR522	*152-0185-00	Silicon	Replaceable by 1N4152
CR523	*152-0185-00	Silicon	Replaceable by 1N4152
CR524	*152-0185-00	Silicon	Replaceable by 1N4152
CR533	*152-0185-00	Silicon	Replaceable by 1N4152
CR534	*152-0185-00	Silicon	Replaceable by 1N4152
CR542	*152-0185-00	Silicon	Replaceable by 1N4152
CR545	*152-0185-00	Silicon	Replaceable by 1N4152
CR548	*152-0185-00	Silicon	Replaceable by 1N4152

Transistors

Q501	151-0224-00	Silicon	2N3692
Q502	151-0224-00	Silicon	2N3692
Q503	151-0224-00	Silicon	2N3692
Q511	*151-0192-00	Silicon	Replaceable by MPS 6521
Q512	151-0224-00	Silicon	2N3692
Q513	151-0224-00	Silicon	2N3692
Q514	*151-0192-00	Silicon	Replaceable by MPS 6521
Q515	151-0220-00	Silicon	2N4122
Q516	151-0224-00	Silicon	2N3692
Q522	*151-0192-00	Silicon	Replaceable by MPS 6521
Q523	*151-0192-00	Silicon	Replaceable by MPS 6521
Q524	*151-0192-00	Silicon	Replaceable by MPS 6521
Q525	151-0224-00	Silicon	2N3692
Q526	151-0224-00	Silicon	2N3692
Q531	*151-0192-00	Silicon	Replaceable by MPS 6521

STAIRCASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
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Transistors (cont)

Q532	*151-0192-00	Silicon	Replaceable by MPS 6521
Q533	*151-0192-00	Silicon	Replaceable by MPS 6521
Q534	*151-0192-00	Silicon	Replaceable by MPS 6521
Q535	151-0224-00	Silicon	2N3692
Q536	151-0224-00	Silicon	2N3692
Q542	151-0224-00	Silicon	2N3692
Q543	*151-0192-00	Silicon	Replaceable by MPS 6521
Q544	*151-0192-00	Silicon	Replaceable by MPS 6521
Q545	151-0224-00	Silicon	2N3692
Q546	151-0225-00	Silicon	2N3563

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R501	321-0431-00	301 k Ω	$\frac{1}{8}$ W	Prec	1%
R502	321-0335-00	30.1 k Ω	$\frac{1}{8}$ W	Prec	1%
R504	321-0339-00	33.2 k Ω	$\frac{1}{8}$ W	Prec	1%
R505	315-0102-00	1 k Ω	$\frac{1}{4}$ W		5%
R512	315-0103-00	10 k Ω	$\frac{1}{4}$ W		5%
R514	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R515	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R521	315-0333-00	33 k Ω	$\frac{1}{4}$ W		5%
R522	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W		5%
R523	315-0471-00	470 Ω	$\frac{1}{4}$ W		5%
R524	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R525	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R531	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R532	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R533	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R534	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R535	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R541	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R542	315-0362-00	3.6 k Ω	$\frac{1}{4}$ W		5%
R543	315-0681-00	680 Ω	$\frac{1}{4}$ W		5%
R544	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R545	321-0262-01	5.23 k Ω	$\frac{1}{8}$ W	Prec	$\frac{1}{2}\%$
R547	315-0272-00	2.7 k Ω	$\frac{1}{4}$ W		5%
R548	315-0202-00	2 k Ω	$\frac{1}{4}$ W		5%
R549	315-0152-00	1.5 k Ω	$\frac{1}{4}$ W		5%

STAIRCASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
Resistors (cont)							
R551	321-0334-00			29.4 kΩ	1/8 W	Prec	1%
R552	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R553	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R554	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R555	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R556	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R557	321-0299-00	B010100	B029999	12.7 kΩ	1/8 W	Prec	1%
R557	321-0295-00	B030000		11.5 kΩ	1/8 W	Prec	1%
R561	311-0883-00			50 kΩ, Var			
R562	311-0953-00			2.5 kΩ, Var			
R563	311-0953-00			2.5 kΩ, Var			
R564	311-0953-00			2.5 kΩ, Var			
R565	311-0953-00			2.5 kΩ, Var			
R566	311-0953-00			2.5 kΩ, Var			
R567	311-0732-00	B010100	B029999	1 kΩ, Var			
R567	311-0953-00	B030000		2.5 kΩ, Var			
Integrated Circuits							
U507	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U508	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U509	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U517	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U518	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U519	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U537	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U538	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U539	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U547	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			
U548	156-0011-00			Medium Power Dual 2-Input Gate Replaceable by Fairchild μL914			

LINE TIMING Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
*670-0306-00		Complete Board				
Capacitors						
Tolerance $\pm 20\%$ unless otherwise indicated.						
C603	283-0032-00			470 pF	Cer	500 V 5%
C606	283-0032-00			470 pF	Cer	500 V 5%
C612	283-0032-00			470 pF	Cer	500 V 5%
C620	283-0149-00			25 pF	Cer	200 V 2%
C621	283-0004-00			0.02 μ F	Cer	150 V
C622	283-0004-00	B010100	B039999	0.02 μ F	Cer	150 V
C622	283-0059-00	B040000		1 μ F	Cer	25 V +80%—20%
C631	283-0594-00			0.001 μ F	Mica	100 V 1%
C641	283-0077-00			330 pF	Cer	500 V 5%
C643	283-0032-00			470 pF	Cer	500 V 5%
C644	283-0617-00			4700 pF	Mica	300 V 10%
C647	283-0004-00			0.02 μ F	Cer	150 V
C648	283-0627-00			0.0033 μ F	Mica	500 V 5%
C649	283-0065-00			0.001 μ F	Cer	100 V 5%
C651	283-0077-00			330 pF	Cer	500 V 5%
C653	283-0032-00			470 pF	Cer	500 V 5%
C654	283-0639-00			56 pF	Mica	100 V 1%
C655	283-0594-00			0.001 μ F	Mica	100 V 1%
C661	283-0077-00			330 pF	Cer	500 V 5%
C663	283-0004-00			0.02 μ F	Cer	150 V
C665	283-0594-00			0.001 μ F	Mica	100 V 1%
C666	290-0246-00			3.3 μ F	Elect.	15 V 10%
C669	283-0622-00			450 pF	Mica	300 V 1%
C671	283-0077-00			330 pF	Cer	500 V 5%
C674	283-0004-00			0.02 μ F	Cer	150 V
C675	283-0004-00			0.02 μ F	Cer	150 V
C676	283-0004-00			0.02 μ F	Cer	150 V
C678	283-0004-00			0.02 μ F	Cer	150 V
C679	283-0004-00			0.02 μ F	Cer	150 V
C681	283-0077-00			330 pF	Cer	500 V 5%
C687	283-0004-00			0.02 μ F	Cer	150 V
C688	283-0003-00			0.01 μ F	Cer	150 V
C691	283-0077-00			330 pF	Cer	150 V 5%
C695	283-0004-00			0.02 μ F	Cer	150 V
C698	283-0004-00			0.02 μ F	Cer	150 V
C699	283-0004-00			0.02 μ F	Cer	150 V

LINE TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Semiconductor Device, Diodes				
CR621	*152-0185-00		Silicon	Replaceable by 1N4152
CR622	*152-0185-00		Silicon	Replaceable by 1N4152
CR648	152-0246-00		Silicon	Low leakage, 250 mW, 40 V
CR653	*152-0269-00		Silicon	Voltage var. cap. Tek Spec
CR654	*152-0185-00		Silicon	Replaceable by 1N4152
CR655	152-0008-00		Germanium	
CR658	*152-0185-00		Silicon	Replaceable by 1N4152
CR664	*152-0185-00		Silicon	Replaceable by 1N4152
CR675	*152-0185-00		Silicon	Replaceable by 1N4152
CR676	*152-0185-00		Silicon	Replaceable by 1N4152
CR677	*152-0185-00		Silicon	Replaceable by 1N4152
CR685	*152-0185-00		Silicon	Replaceable by 1N4152
CR697	*152-0185-00		Silicon	Replaceable by 1N4152
Transistors				
Q610	151-0225-00		Silicon	2N3563
Q621	151-0224-00		Silicon	2N3692
Q622	151-0224-00		Silicon	2N3692
Q642	151-0224-00		Silicon	2N3692
Q643	151-0220-00		Silicon	2N4122
Q644	151-0220-00		Silicon	2N4122
Q645	151-0220-00		Silicon	2N4122
Q646	*151-0192-00		Silicon	Replaceable by MPS 6521
Q647	*151-0192-00		Silicon	Replaceable by MPS 6521
Q648	*151-0192-00		Silicon	Replaceable by MPS 6521
Q649	151-0224-00		Silicon	2N3692
Q652	151-0224-00		Silicon	2N3692
Q656	151-0220-00		Silicon	2N4122
Q662	151-0224-00		Silicon	2N3692
Q666	*151-0192-00		Silicon	Replaceable by MPS 6521
Q667	*151-0192-00		Silicon	Replaceable by MPS 6521
Q668	*151-0219-00		Silicon	Replaceable by 2N4250
Q669	151-0223-00		Silicon	2N4275
Q672	151-0224-00		Silicon	2N3692
Q673	151-1011-01	B010100	Silicon	Dual, FET
Q673	151-1041-00	B050000	Silicon	Dual, FET
Q674	151-0190-00		Silicon	2N3904
Q675	*151-0192-00		Silicon	Replaceable by MPS 6521
Q676	151-0220-00		Silicon	2N4122
Q677	151-0220-00		Silicon	2N4122
Q682	151-0224-00		Silicon	2N3692

LINE TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description			
Transistors (cont)						
Q683	*151-0216-00		Silicon	Replaceable by MOT MPS 6523		
Q684	*151-0219-00		Silicon	Replaceable by 2N4250		
Q686	151-0220-00		Silicon	2N4122		
Q687	151-0190-00		Silicon	2N3904		
Q688	151-0190-00		Silicon	2N3904		
Q691	151-0224-00		Silicon	2N3692		
Q692	151-0224-00		Silicon	2N3692		
Q693	*151-0216-00		Silicon	Replaceable by MOT MPS 6523		
Q694	*151-0219-00		Silicon	Replaceable by 2N4250		
Q696	151-0220-00		Silicon	2N4122		
Resistors						
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.						
R641	311-0704-00		500 Ω , Var			
R651	311-0704-00		500 Ω , Var			
R661	311-0704-00		500 Ω , Var			
R671	311-0704-00		500 Ω , Var			
R681	311-0704-00		500 Ω , Var			
R691	311-0732-00		1 k Ω , Var			
R6000	315-0202-00		2 k Ω	1/4 W		5%
R6010	315-0222-00		2.2 k Ω	1/4 W		5%
R6020	315-0243-00		24 k Ω	1/4 W		5%
R6030	315-0202-00		2 k Ω	1/4 W		5%
R6040	315-0222-00		2.2 k Ω	1/4 W		5%
R6050	315-0202-00		2 k Ω	1/4 W		5%
R6100	315-0222-00		2.2 k Ω	1/4 W		5%
R6110	315-0103-00		10 k Ω	1/4 W		5%
R6120	315-0222-00		2.2 k Ω	1/4 W		5%
R6121	315-0222-00		2.2 k Ω	1/4 W		5%
R6130	315-0222-00		2.2 k Ω	1/4 W		5%
R6190	315-0222-00		2.2 k Ω	1/4 W		5%
R6210	315-0223-00		22 k Ω	1/4 W		5%
R6220	315-0222-00		2.2 k Ω	1/4 W		5%
R6221	321-0316-00		19.1 k Ω	1/8 W	Prec	1%
R6230	315-0471-00		470 Ω	1/4 W		5%
R6250	315-0100-00		10 Ω	1/4 W		5%
R6260	315-0512-00		5.1 k Ω	1/4 W		5%
R6330	315-0753-00		75 k Ω	1/4 W		5%
R6331	315-0222-00		2.2 k Ω	1/4 W		5%
R6350	315-0121-00		120 Ω	1/4 W		5%
R6400	321-0252-00		4.12 k Ω	1/8 W	Prec	1%
R6420	321-0286-00	B010100	9.31 k Ω	1/8 W	Prec	1%
R6420	321-0284-00	B040000	8.87 k Ω	1/8 W	Prec	1%
R6430	315-0753-00		75 k Ω	1/4 W		5%

LINE TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description		
Resistors (cont)						
R6440	315-0153-00		15 kΩ	1/4 W		5%
R6450	315-0300-00		30 Ω	1/4 W		5%
R6451	315-0561-00		560 Ω	1/4 W		5%
R6460	315-0331-00		330 Ω	1/4 W		5%
R6461	321-0366-00		63.4 kΩ	1/8 W	Prec	1%
R6470	315-0102-00		1 kΩ	1/4 W		5%
R6471	317-0107-00		100 MΩ	1/8 W		5%
R6472	321-0377-00		82.5 kΩ	1/8 W	Prec	1%
R6480	315-0104-00		100 kΩ	1/4 W		5%
R6481	315-0102-00		1 kΩ	1/4 W		5%
R6490	315-0223-00		22 kΩ	1/4 W		5%
R6491	315-0223-00		22 kΩ	1/4 W		5%
R6500	321-0249-00		3.83 kΩ	1/8 W	Prec	1%
R6520	321-0295-00		11.5 kΩ	1/8 W	Prec	1%
R6540	321-0510-00		2 MΩ	1/8 W	Prec	1%
R6550	315-0105-00		1 MΩ	1/4 W		5%
R6560	315-0103-00		10 kΩ	1/4 W		5%
R6570	315-0103-00		10 kΩ	1/4 W		5%
R6580	315-0220-00		22 Ω	1/4 W		5%
R6581	315-0153-00		15 kΩ	1/4 W		5%
R6590	315-0103-00		10 kΩ	1/4 W		5%
R6600	321-0247-00	B010100	3.65 kΩ	1/8 W	Prec	1%
R6600	321-0249-00	B030000	3.83 Ω	1/8 W	Prec	1%
R6620	321-0298-00		12.4 kΩ	1/8 W	Prec	1%
R6630	315-0124-00		120 kΩ	1/4 W		5%
R6631	315-0106-00		10 MΩ	1/4 W		5%
R6640	321-0510-00		2 MΩ	1/8 W	Prec	1%
R6650	315-0124-00		120 kΩ	1/4 W		5%
R6660	315-0274-00		270 kΩ	1/4 W		5%
R6670	321-0281-00		8.25 kΩ	1/8 W	Prec	1%
R6671	321-0270-00		6.34 kΩ	1/8 W	Prec	1%
R6700	321-0243-00		3.32 kΩ	1/8 W	Prec	1%
R6720	321-0314-00		18.2 kΩ	1/8 W	Prec	1%
R6730	315-0101-00		100 Ω	1/4 W		5%
R6731	315-0363-00		36 kΩ	1/4 W		5%
R6740	315-0152-00		1.5 kΩ	1/4 W		5%
R6741	321-0251-00		4.02 kΩ	1/8 W	Prec	1%
R6750	315-0331-00		330 Ω	1/4 W		5%
R6760	315-0472-00		4.7 kΩ	1/4 W		5%
R6761	315-0472-00		4.7 kΩ	1/4 W		5%
R6770	321-0260-00		4.99 kΩ	1/8 W	Prec	1%

LINE TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description	
Resistors (cont)				
R6771	315-0432-00	4.3 k Ω	$\frac{1}{4}$ W	5%
R6772	321-0251-00	4.02 k Ω	$\frac{1}{8}$ W	Prec 1%
R6780	321-0283-00	8.66 k Ω	$\frac{1}{8}$ W	Prec 1%
R6781	321-0302-00	13.7 k Ω	$\frac{1}{8}$ W	Prec 1%
R6782	315-0752-00	7.5 k Ω	$\frac{1}{4}$ W	5%
R6790	315-0202-00	2 k Ω	$\frac{1}{4}$ W	5%
R6791	315-0562-00	5.6 k Ω	$\frac{1}{4}$ W	5%
R6792	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R6800	321-0223-00	2.05 k Ω	$\frac{1}{8}$ W	Prec 1%
R6820	321-0312-00	17.4 k Ω	$\frac{1}{8}$ W	Prec 1%
R6830	315-0153-00	15 k Ω	$\frac{1}{4}$ W	5%
R6831	315-0682-00	6.8 k Ω	$\frac{1}{4}$ W	5%
R6840	315-0912-00	9.1 k Ω	$\frac{1}{4}$ W	5%
R6841	321-0260-00	4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R6850	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R6860	315-0472-00	4.7 k Ω	$\frac{1}{4}$ W	5%
R6870	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R6871	315-0332-00	3.3 k Ω	$\frac{1}{4}$ W	5%
R6880	315-0182-00	1.8 k Ω	$\frac{1}{4}$ W	5%
R6881	315-0100-00	10 k Ω	$\frac{1}{4}$ W	5%
R6890	315-0470-00	47 Ω	$\frac{1}{4}$ W	5%
R6900	321-0235-00	2.74 k Ω	$\frac{1}{8}$ W	Prec 1%
R6920	321-0350-00	43.2 k Ω	$\frac{1}{8}$ W	Prec 1%
R6930	315-0363-00	36 k Ω	$\frac{1}{4}$ W	5%
R6931	315-0101-00	100 Ω	$\frac{1}{4}$ W	5%
R6932	315-0153-00	15 k Ω	$\frac{1}{4}$ W	5%
R6940	321-0260-00	4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R6950	315-0122-00	1.2 k Ω	$\frac{1}{4}$ W	5%
R6951	321-0260-00	4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R6960	315-0472-00	4.7 k Ω	$\frac{1}{4}$ W	5%
R6970	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R6980	315-0103-00	10 k Ω	$\frac{1}{4}$ W	5%
R6990	315-0470-00	47 Ω	$\frac{1}{4}$ W	5%

Transformer

T655	*120-0564-00	Toroid, 3 windings
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LINE TIMING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Integrated Circuits			
U601	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U602	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U603	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U605	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U606	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U607	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U609	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U612	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U613	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U615	156-0010-00		Buffer-Inverter. Replaceable by Fairchild μ L900
U616	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U617	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U619	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U623	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U625	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U626	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U627	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U629	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U633	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U635	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U636	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U637	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U639	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
Crystal			
Y643	158-0039-00		1.006993 MHz

CROSS HATCH Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
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*670-0307-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C702	283-0104-00		2000 pF	Cer	500 V	5%
C705	285-0703-00		0.1 μ F	PTM	100 V	5%
C706	283-0083-00		0.0047 μ F	Cer	500 V	5%
C712	283-0065-00		0.001 μ F	Cer	100 V	5%
C716	283-0083-00		0.0047 μ F	Cer	500 V	5%
C717	290-0134-00		22 μ F	Elect.	15 V	
C718	290-0134-00		22 μ F	Elect.	15 V	
C726	283-0032-00		470 pF	Cer	500 V	5%
C727	283-0003-00		0.01 μ F	Cer	150 V	
C738	281-0613-00	XB050000	10 pF	Cer	200 V	10%
C749	283-0080-00		0.022 μ F	Cer	25 V	+80% -20%
C752	283-0026-00		0.2 μ F	Cer	25 V	
C759	283-0632-00		87 pF	Mica	100 V	1%
C761	283-0594-00		0.001 μ F	Mica	100 V	1%
C764	283-0047-00		270 pF	Cer	500 V	5%
C767	283-0596-00		528 pF	Mica	300 V	1%
C768	283-0602-00		53 pF	Mica	300 V	5%
C777	283-0026-00		0.2 μ F	Cer	25 V	
C779	283-0610-00		220 pF	Mica	500 V	
C782	290-0134-00		22 μ F	Elect.	15 V	
C783	283-0026-00		0.2 μ F	Cer	25 V	
C785	283-0644-00		150 pF	Mica	500 V	1%
C792	283-0641-00		180 pF	Mica	100 V	1%
C795	283-0644-00		150 pF	Mica	500 V	1%
C796	283-0026-00		0.2 μ F	Cer	25 V	

Semiconductor Device, Diodes

CR703	152-0008-00	Germanium	
CR749	*152-0185-00	Silicon	Replaceable by 1N4152
CR762	*152-0185-00	Silicon	Replaceable by 1N4152
CR781	*152-0185-00	Silicon	Replaceable by 1N4152
CR784	*152-0185-00	Silicon	Replaceable by 1N4152
CR787	*152-0185-00	Silicon	Replaceable by 1N4152
CR791	*152-0185-00	Silicon	Replaceable by 1N4152
CR794	*152-0185-00	Silicon	

CROSS HATCH Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Inductors				
L768	*114-0222-00		2-6 μ H, Var	Core 276-0568-00
L769	*114-0222-00		2-6 μ H, Var	Core 276-0568-00
L791	114-0177-00		280-650 μ H, Var	Core 276-0506-00
Transistors				
Q704	*151-0219-00		Silicon	Replaceable by 2N4250
Q705	*151-0219-00		Silicon	Replaceable by 2N4250
Q714	151-0190-00		Silicon	2N3904
Q715	151-0190-00		Silicon	2N3904
Q728	*151-0103-00		Silicon	Replaceable by 2N2219
Q737	151-0220-00		Silicon	2N4122
Q738	*151-0219-00		Silicon	Replaceable by 2N4250
Q739	*151-0195-00		Silicon	Replaceable by MPS 6515
Q751	*151-0219-00		Silicon	Replaceable by 2N4250
Q752	*151-0219-00		Silicon	Replaceable by 2N4250
Q761	151-0190-00		Silicon	2N3904
Q762	151-0190-00		Silicon	2N3904
Q776	151-0190-00		Silicon	2N3904
Q777	*151-0219-00		Silicon	Replaceable by 2N4250
Q783	151-0224-00		Silicon	2N3692
Q784	151-0220-00		Silicon	2N4122
Q786	151-0221-00		Silicon	2N4258
Q787	*151-0195-00		Silicon	Replaceable by MPS 6515
Q788	*151-0195-00		Silicon	Replaceable by MPS 6515
Q789	*151-0195-00		Silicon	Replaceable by MPS 6515
Q793	151-0225-00		Silicon	2N3563
Q794	151-0220-00		Silicon	2N4122
Q796	151-0190-00		Silicon	2N3904
Q797	*151-0198-00		Silicon	Replaceable by MPS 918
Q798	151-0190-00		Silicon	2N3904
Q799	151-0190-00		Silicon	2N3904

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R702	315-0272-00	2.7 k Ω	1/4 W		5%
R703	321-0122-00	182 Ω	1/8 W	Prec	1%
R704	321-0225-00	2.15 k Ω	1/8 W	Prec	1%
R705	321-0300-00	13 k Ω	1/8 W	Prec	1%
R706	315-0432-00	4.3 k Ω	1/4 W		5%

CROSS HATCH Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R707	315-0101-00		100 Ω	$\frac{1}{4}$ W	WW	5%
R709	308-0252-00		390 Ω	3 W		5%
R711	315-0272-00		2.7 k Ω	$\frac{1}{4}$ W		5%
R713	315-0681-00		680 Ω	$\frac{1}{4}$ W		5%
R714	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R716	315-0562-00		5.6 k Ω	$\frac{1}{4}$ W	Prec	5%
R718	321-0085-00		75 Ω	$\frac{1}{8}$ W		1%
R719	321-0085-00		75 Ω	$\frac{1}{8}$ W		1%
R726	315-0202-00		2 k Ω	$\frac{1}{4}$ W		5%
R727	315-0431-00		430 Ω	$\frac{1}{4}$ W		5%
R728	315-0302-00		3 k Ω	$\frac{1}{4}$ W	Prec	5%
R729	311-0884-00		100 Ω , Var			
R736	315-0243-00		24 k Ω	$\frac{1}{4}$ W		5%
R738	321-0229-00		2.37 k Ω	$\frac{1}{8}$ W		1%
R739	321-0179-00		715 Ω	$\frac{1}{8}$ W		1%
R744	315-0181-00		180 Ω	$\frac{1}{4}$ W	Prec	5%
R745	315-0162-00		1.6 k Ω	$\frac{1}{4}$ W		5%
R747	321-0210-00		1.5 k Ω	$\frac{1}{8}$ W		1%
R748	321-0147-00		332 Ω	$\frac{1}{8}$ W		1%
R749	321-0281-00		8.25 k Ω	$\frac{1}{8}$ W		1%
R751	321-0242-00		3.24 k Ω	$\frac{1}{8}$ W	Prec	1%
R752	321-0269-00		6.19 k Ω	$\frac{1}{8}$ W		1%
R753	315-0470-00		47 Ω	$\frac{1}{4}$ W		5%
R754	315-0222-00		2.2 k Ω	$\frac{1}{4}$ W		5%
R757	321-0210-00		1.5 k Ω	$\frac{1}{8}$ W		1%
R758	321-0256-00	B010100 B040000	4.53 k Ω	$\frac{1}{8}$ W	Prec	1%
R759	321-0105-00		121 Ω	$\frac{1}{8}$ W	Prec	1%
R759	321-0108-00		130 Ω	$\frac{1}{8}$ W	Prec	1%
R760	321-0196-00		1.07 k Ω	$\frac{1}{8}$ W	Prec	1%
R761	315-0562-00		5.6 k Ω	$\frac{1}{4}$ W		5%
R762	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R763	315-0273-00		27 k Ω	$\frac{1}{4}$ W	Prec	5%
R764	315-0470-00		47 Ω	$\frac{1}{4}$ W		5%
R765	321-0310-00		16.5 k Ω	$\frac{1}{8}$ W		1%
R766	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R768	315-0470-00		47 Ω	$\frac{1}{4}$ W		5%
R770	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R771	315-0432-00		4.3 k Ω	$\frac{1}{4}$ W		5%
R772	315-0102-00		1 k Ω	$\frac{1}{4}$ W		5%
R773	315-0470-00		47 Ω	$\frac{1}{4}$ W		5%
R774	315-0472-00		4.7 k Ω	$\frac{1}{4}$ W		5%

CROSS HATCH Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description			
Resistors (cont)						
R775	321-0270-00	6.34 kΩ	1/8 W	Prec		1%
R776	315-0102-00	1 kΩ	1/4 W			5%
R777	315-0470-00	47 Ω	1/4 W			5%
R778	315-0470-00	47 Ω	1/4 W			5%
R783	315-0202-00	2 kΩ	1/4 W			5%
R784	315-0471-00	470 Ω	1/4 W			5%
R787	321-0284-00	8.87 kΩ	1/8 W	Prec		1%
R788	321-0375-00	78.7 kΩ	1/8 W	Prec		1%
R789	321-0318-00	20 kΩ	1/8 W	Prec		1%
R791	315-0681-00	680 Ω	1/4 W			5%
R792	315-0102-00	1 kΩ	1/4 W			5%
R793	315-0132-00	1.3 kΩ	1/4 W			5%
R794	315-0132-00	1.3 kΩ	1/4 W			5%
R795	315-0103-00	10 kΩ	1/4 W			5%
R796	315-0162-00	1.6 kΩ	1/4 W			5%
R797	315-0102-00	1 kΩ	1/4 W			5%

Integrated Circuits

U711	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U712	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U721	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U722	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U723	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U724	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U725	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U731	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U732	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U733	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U734	156-0012-00	Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U735	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U741	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U742	156-0011-00	Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914

CROSS HATCH Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
Integrated Circuits (cont)			
U743	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U744	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U745	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914
U775	156-0012-00		Clocked J-K Flipflop. Replaceable by Fairchild μ L923
U785	156-0011-00		Medium Power Dual 2-Input Gate Replaceable by Fairchild μ L914

OUTPUT AMP Circuit Board Assembly

*670-0308-00

Complete Board**Capacitors**Tolerance $\pm 20\%$ unless otherwise indicated.

C903	283-0596-00	528 pF	Mica	300 V	1%
C904	283-0602-00	53 pF	Mica	300 V	5%
C905	283-0632-00	87 pF	Mica	100 V	1%
C906	283-0610-00	220 pF	Mica	500 V	
C912	283-0004-00	0.02 μ F	Cer	150 V	
C914	290-0415-00	5.6 μ F	Elect.	35 V	10%
C916	283-0004-00	0.02 μ F	Cer	150 V	
C923	283-0596-00	528 pF	Mica	300 V	1%
C924	283-0602-00	53 pF	Mica	300 V	5%
C925	283-0632-00	87 pF	Mica	100 V	1%
C926	283-0610-00	220 pF	Mica	500 V	
C932	283-0004-00	0.02 μ F	Cer	150 V	
C934	290-0415-00	5.6 μ F	Elect.	35 V	10%
C936	283-0004-00	0.02 μ F	Cer	150 V	
C943	283-0596-00	528 pF	Mica	300 V	1%
C944	283-0602-00	53 pF	Mica	300 V	5%
C945	283-0632-00	87 pF	Mica	100 V	1%
C946	283-0610-00	220 pF	Cer	500 V	
C952	283-0004-00	0.02 μ F	Cer	150 V	
C954	290-0415-00	5.6 μ F	Elect.	35 V	10%
C956	283-0004-00	0.02 μ F	Cer	150 V	
C963	283-0596-00	528 pF	Mica	300 V	1%
C964	283-0602-00	53 pF	Mica	300 V	5%
C965	283-0632-00	87 pF	Mica	100 V	1%
C966	283-0610-00	220 pF	Mica	500 V	

OUTPUT AMP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description			
Capacitors (cont)						
C972	283-0004-00	0.02 μ F	Cer	150 V		
C974	290-0415-00	5.6 μ F	Elect.	35 V	10%	
C976	283-0004-00	0.02 μ F	Cer	150 V		
C981	290-0296-00	100 μ F	Elect.	20 V		
C982	290-0409-00	1000 μ F	Elect.	25 V	+75% - 10%	
C983	283-0596-00	528 pF	Mica	300 V	1%	
C984	283-0602-00	53 pF	Mica	300 V	5%	
C985	283-0632-00	87 pF	Mica	100 V	1%	
C986	283-0610-00	220 pF	Mica	500 V		
C989	290-0134-00	22 μ F	Elect.	15 V		
C992	283-0004-00	0.02 μ F	Cer	150 V		
C994	290-0415-00	5.6 μ F	Elect.	35 V	10%	
C996	283-0004-00	0.02 μ F	Cer	150 V		
Semiconductor Device, Diodes						
CR906	*152-0185-00	Silicon	Replaceable by 1N4152			
CR926	*152-0185-00	Silicon	Replaceable by 1N4152			
CR946	*152-0185-00	Silicon	Replaceable by 1N4152			
CR966	*152-0185-00	Silicon	Replaceable by 1N4152			
CR986	*152-0185-00	Silicon	Replaceable by 1N4152			
Inductors						
L904	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L905	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L924	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L925	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L944	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L945	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L964	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L965	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L984	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
L985	*114-0222-00	2-6 μ H, Var	Core 276-0568-00			
Transistors						
Q900	151-0220-00	Silicon	2N4122			
Q902	151-0220-00	Silicon	2N4122			
Q910	151-0220-00	Silicon	2N4122			
Q912	151-0221-00	Silicon	2N4258			
Q914	151-0190-00	Silicon	2N3904			

OUTPUT AMP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Transistors (cont)				
Q916	151-0164-00		Silicon	2N3702
Q920	151-0220-00		Silicon	2N4122
Q922	151-0220-00		Silicon	2N4122
Q930	151-0220-00		Silicon	2N4122
Q932	151-0221-00		Silicon	2N4258
Q934	151-0190-00		Silicon	2N3904
Q936	151-0164-00		Silicon	2N3702
Q940	151-0220-00		Silicon	2N4122
Q942	151-0220-00		Silicon	2N4122
Q950	151-0220-00		Silicon	2N4122
Q952	151-0221-00		Silicon	2N4258
Q954	151-0190-00		Silicon	2N3904
Q956	151-0164-00		Silicon	2N3702
Q960	151-0220-00		Silicon	2N4122
Q962	151-0220-00		Silicon	2N4122
Q964	151-0190-00		Silicon	2N3904
Q970	151-0220-00		Silicon	2N4122
Q972	151-0221-00		Silicon	2N4258
Q974	151-0190-00		Silicon	2N3904
Q976	151-0164-00		Silicon	2N3702
Q978	151-0164-00		Silicon	2N3702
Q980	151-0220-00		Silicon	2N4122
Q982	151-0220-00		Silicon	2N4122
Q990	151-0220-00		Silicon	2N4122
Q992	151-0221-00		Silicon	2N4258
Q994	151-0190-00		Silicon	2N3904
Q996	151-0164-00		Silicon	2N3702
Q998	151-0164-00		Silicon	2N3702

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R900	315-0220-00			22 Ω	$\frac{1}{4}$ W		5%
R901	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec	1%
R902	315-0101-00			100 Ω	$\frac{1}{4}$ W		5%
R905	321-0105-00	B010100	B039999	121 Ω	$\frac{1}{8}$ W	Prec	1%
R905	321-0108-00	B040000		130 Ω	$\frac{1}{8}$ W	Prec	1%
R906	321-0260-00			4.99 k Ω	$\frac{1}{8}$ W	Prec	1%
R907	315-0103-00			10 k Ω	$\frac{1}{4}$ W		5%
R908	321-0275-00			7.15 k Ω	$\frac{1}{8}$ W	Prec	1%
R909	315-0202-00			2 k Ω	$\frac{1}{4}$ W		5%
R910	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec	1%
R911	322-0085-00			75 Ω	$\frac{1}{4}$ W	Prec	1%

OUTPUT AMP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R912	315-0563-00			56 k Ω	$\frac{1}{4}$ W	5%
R913	315-0102-00			1 k Ω	$\frac{1}{4}$ W	5%
R914	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R916	315-0100-00			10 Ω	$\frac{1}{4}$ W	5%
R920	315-0220-00			22 Ω	$\frac{1}{4}$ W	5%
R921	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R922	315-0101-00			100 Ω	$\frac{1}{4}$ W	5%
R925	321-0105-00	B010100	B039999	121 Ω	$\frac{1}{8}$ W	Prec 1%
R925	321-0108-00	B040000		130 Ω	$\frac{1}{8}$ W	Prec 1%
R926	321-0260-00			4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R927	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R928	321-0275-00			7.15 k Ω	$\frac{1}{8}$ W	Prec 1%
R929	315-0202-00			2 k Ω	$\frac{1}{4}$ W	5%
R930	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R931	322-0085-00			75 Ω	$\frac{1}{4}$ W	Prec 1%
R932	315-0563-00			56 k Ω	$\frac{1}{4}$ W	5%
R933	315-0102-00			1 k Ω	$\frac{1}{4}$ W	5%
R934	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R936	315-0100-00			10 Ω	$\frac{1}{4}$ W	5%
R940	315-0220-00			22 Ω	$\frac{1}{4}$ W	5%
R941	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R942	315-0101-00			100 Ω	$\frac{1}{4}$ W	5%
R944	301-0430-00			43 Ω	$\frac{1}{2}$ W	5%
R945	321-0105-00	B010100	B039999	121 Ω	$\frac{1}{8}$ W	Prec 1%
R945	321-0108-00	B040000		130 Ω	$\frac{1}{8}$ W	Prec 1%
R946	321-0260-00			4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R947	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R948	321-0275-00			7.15 k Ω	$\frac{1}{8}$ W	Prec 1%
R949	315-0202-00			2 k Ω	$\frac{1}{4}$ W	5%
R950	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R951	322-0085-00			75 Ω	$\frac{1}{4}$ W	Prec 1%
R952	315-0563-00			56 k Ω	$\frac{1}{4}$ W	5%
R953	315-0102-00			1 k Ω	$\frac{1}{4}$ W	5%
R954	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R956	315-0100-00			10 Ω	$\frac{1}{4}$ W	5%
R960	315-0220-00			22 Ω	$\frac{1}{4}$ W	5%
R961	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R962	315-0101-00			100 Ω	$\frac{1}{4}$ W	5%
R964	321-0282-00			8.45 k Ω	$\frac{1}{8}$ W	Prec 1%
R965	321-0105-00	B010100	B039999	121 Ω	$\frac{1}{8}$ W	Prec 1%
R965	321-0108-00	B040000		130 Ω	$\frac{1}{8}$ W	Prec 1%
R966	321-0260-00			4.99 k Ω	$\frac{1}{8}$ W	Prec 1%
R967	315-0103-00			10 k Ω	$\frac{1}{4}$ W	5%
R968	321-0275-00			7.15 k Ω	$\frac{1}{8}$ W	Prec 1%
R969	315-0202-00			2 k Ω	$\frac{1}{4}$ W	5%
R970	321-0222-00			2 k Ω	$\frac{1}{8}$ W	Prec 1%
R971	322-0085-00			75 Ω	$\frac{1}{4}$ W	Prec 1%
R972	315-0563-00			56 k Ω	$\frac{1}{4}$ W	5%

OUTPUT AMP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
Resistors (cont)						
R973	315-0102-00			1 k Ω	1/4 W	5%
R974	315-0103-00			10 k Ω	1/4 W	5%
R975	307-0113-00			5.1 Ω	1/4 W	5%
R976	315-0100-00			10 Ω	1/4 W	5%
R977	307-0113-00			5.1 Ω	1/4 W	5%
R978	322-0085-00			75 Ω	1/4 W	Prec 1%
R979	315-0100-00			10 Ω	1/4 W	5%
R980	315-0220-00			22 Ω	1/4 W	5%
R981	321-0222-00			2 k Ω	1/8 W	Prec 1%
R982	315-0101-00			100 Ω	1/4 W	5%
R983	321-0213-00			1.62 k Ω	1/8 W	Prec 1%
R984	315-0822-00			8.2 k Ω	1/4 W	5%
R985	321-0105-00	B010100	B039999	121 Ω	1/8 W	Prec 1%
R985	321-0108-00	B040000		130 Ω	1/8 W	Prec 1%
R986	321-0260-00			4.99 k Ω	1/8 W	Prec 1%
R987	315-0103-00			10 k Ω	1/4 W	5%
R988	321-0275-00			7.15 k Ω	1/8 W	Prec 1%
R989	315-0202-00			2 k Ω	1/4 W	5%
R990	321-0222-00			2 k Ω	1/8 W	Prec 1%
R991	322-0085-00			75 Ω	1/4 W	Prec 1%
R992	315-0563-00			56 k Ω	1/4 W	5%
R993	315-0102-00			1 k Ω	1/4 W	1%
R994	315-0103-00			10 k Ω	1/4 W	5%
R995	307-0113-00			5.1 Ω	1/4 W	5%
R996	315-0100-00			10 Ω	1/4 W	5%
R997	307-0113-00			5.1 Ω	1/4 W	5%
R998	322-0085-00			75 Ω	1/4 W	Prec 1%
R999	315-0100-00			10 Ω	1/4 W	5%

SUBCARRIER OUTPUT Circuit Board Assembly

*670-0309-00

Complete Board

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C1149	283-0641-00	180 pF	Mica	100 V	1%
C1150	283-0080-00	0.022 μ F	Cer	25 V	+80%—20%
C1152	283-0640-00	160 pF	Mica	100 V	1%
C1156	290-0134-00	22 μ F	Elect.	15 V	
C1157	283-0030-00	0.022 μ F	Cer	25 V	+80%—20%

SUBCARRIER OUTPUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
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Capacitors (cont)

C1158	290-0134-00	22 μ F	Elect. 15 V
C1165	283-0080-00	0.022 μ F	Cer 25 V +80%—20%
C1186	283-0080-00	0.022 μ F	Cer 25 V +80%—20%
C1190	283-0641-00	180 pF	Mica 100 V 1%
C1192	283-0641-00	180 pF	Mica 100 V 1%

Semiconductor Device, Diodes

CR1105	*152-0185-00	Silicon	Replaceable by 1N4152
CR1110	*152-0185-00	Silicon	Replaceable by 1N4152
CR1115	*152-0185-00	Silicon	Replaceable by 1N4152
CR1156	*152-0185-00	Silicon	Replaceable by 1N4152

Inductors

L1147	*114-0280-00	12-43 μ H, Var	Core 276-0568-00
L1197	*114-0280-00	12-43 μ H, Var	Core 276-0568-00

Transistors

Q1101	*151-0195-00	Silicon	Replaceable by MPS 6515
Q1105	151-0225-00	Silicon	2N3563
Q1106	151-0225-00	Silicon	2N3563
Q1111	*151-0192-00	Silicon	Replaceable by MPS 6521
Q1118	151-0224-00	Silicon	2N3692
Q1138	151-0224-00	Silicon	2N3692
Q1159	*151-0103-00	Silicon	Replaceable by 2N2219
Q1168	151-0225-00	Silicon	2N3563
Q1179	151-0225-00	Silicon	2N3563

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R1104	315-0242-00	2.4 k Ω	$\frac{1}{4}$ W		5%
R1105	321-0332-00	28 k Ω	$\frac{1}{8}$ W	Prec	1%
R1107	315-0102-00	1 k Ω	$\frac{1}{4}$ W		5%
R1110	315-0303-00	30 k Ω	$\frac{1}{4}$ W		5%
R1111	322-0157-00	422 Ω	$\frac{1}{4}$ W	Prec	1%

SUBCARRIER OUTPUT Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description			
Resistors (cont)						
R1112	315-0302-00	3 kΩ	1/4 W			5%
R1114	315-0272-00	2.7 kΩ	1/4 W			5%
R1116	315-0203-00	20 kΩ	1/4 W			5%
R1119	315-0102-00	1 kΩ	1/4 W			5%
R1120	315-0102-00	1 kΩ	1/4 W			5%
R1121	321-0312-00	17.4 kΩ	1/8 W	Prec		1%
R1130	315-0470-00	47 Ω	1/4 W			5%
R1146	315-0470-00	47 Ω	1/4 W			5%
R1149	315-0470-00	47 Ω	1/4 W			5%
R1156	308-0243-00	240 Ω	3 W	WW		5%
R1157	315-0101-00	100 Ω	1/4 W			5%
R1158	322-0085-00	75 Ω	1/4 W	Prec		1%
R1159	322-0085-00	75 Ω	1/4 W	Prec		1%
R1160	321-0251-00	4.02 kΩ	1/8 W	Prec		1%
R1162	321-0293-00	11 kΩ	1/8 W	Prec		1%
R1165	315-0182-00	1.8 kΩ	1/4 W			5%
R1170	321-0277-00	7.5 kΩ	1/8 W	Prec		1%
R1176	321-0235-00	2.74 kΩ	1/8 W	Prec		1%
R1178	315-0332-00	3.3 kΩ	1/4 W			5%
R1186	315-0470-00	47 Ω	1/4 W			5%
R1192	321-0235-00	2.74 kΩ	1/8 W	Prec		1%
R1194	Selected					
R1195	311-0836-00	5 kΩ, Var				
R1196	Selected					

SUBCARRIER OSC Circuit Board Assembly

*670-0310-00

Complete Board

CapacitorsTolerance $\pm 20\%$ unless otherwise indicated.

C1122	283-0103-00	180 pF	Cer	500 V	5%
C1123	283-0103-00	180 pF	Cer	500 V	5%
C1124	281-0616-00	6.8 pF	Cer	200 V	
C1125	283-0028-00	0.0022 μ F	Cer	50 V	
C1130	283-0080-00	0.022 μ F	Cer	25 V	+80% —20%
C1131	283-0059-00	1 μ F	Cer	25 V	+80% —20%
C1133	283-0178-00	0.1 μ F	Cer	100 V	+80% —20%

Semiconductor Device, Diode

CR1122	*152-0269-00	Silicon	Voltage var. cap.	Tek Spec
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SUBCARRIER OSC Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
Transistors				
Q1126	*151-0198-00		Silicon	Replaceable by MPS 918
Q1127	*151-0198-00		Silicon	Replaceable by MPS 918
Q1133	*151-0195-00		Silicon	Replaceable by MPS 6515
Q1135	151-0232-00		Silicon	Dual

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R1122	315-0124-00	120 k Ω	$\frac{1}{4}$ W	5%
R1123	315-0124-00	120 k Ω	$\frac{1}{4}$ W	5%
R1124	315-0753-00	75 k Ω	$\frac{1}{4}$ W	5%
R1125	315-0363-00	36 k Ω	$\frac{1}{4}$ W	5%
R1126	315-0153-00	15 k Ω	$\frac{1}{4}$ W	5%
R1127	315-0121-00	120 Ω	$\frac{1}{4}$ W	5%
R1128	315-0820-00	82 Ω	$\frac{1}{4}$ W	5%
R1129	315-0102-00	1 k Ω	$\frac{1}{4}$ W	5%
R1132	315-0271-00	270 Ω	$\frac{1}{4}$ W	5%
R1133	315-0332-00	3.3 k Ω	$\frac{1}{4}$ W	5%
R1138	321-0249-00	3.83 k Ω	$\frac{1}{8}$ W	Prec 1%
R1139	321-0237-00	2.87 k Ω	$\frac{1}{8}$ W	Prec 1%

Crystal

Y1126	158-0036-00	3.579545 MHz
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POWER SUPPLY Circuit Board Assembly

*670-0324-00

Complete Board

CapacitorsTolerance $\pm 20\%$ unless otherwise indicated.

C816	283-0000-00	0.001 μ F	Cer	500 V
C835	290-0162-00	22 μ F	Elect.	35 V
C850	283-0002-00	0.01 μ F	Cer	500 V
C855	290-0171-00	100 μ F	Elect.	12 V
C871	283-0026-00	0.2 μ F	Cer	25 V

POWER SUPPLY Circuit Board Assembly (cont)

Ckt. No.	Tektronix	Serial/Model No.		Description		
	Part No.	Eff	Disc			
Capacitors (cont)						
C875	283-0000-00		0.001 μF	Cer	500 V	
C880	283-0010-00		0.05 μF	Cer	50 V	
C885	290-0312-00		47 μF	Elect.	35 V	10%

Semiconductor Device, Diodes

CR811	152-0066-00		Silicon	1N3194		
CR812	152-0066-00		Silicon	1N3194		
CR813	152-0066-00		Silicon	1N3194		
CR814	152-0066-00		Silicon	1N3194		
CR815	*152-0185-00		Silicon	Replaceable by 1N4152		
CR841	152-0198-00		Silicon	MR1032A	200 V PIV	
CR842	152-0198-00		Silicon	MR1032A	200 V PIV	
CR861	152-0066-00		Silicon	1N3194		
CR962	152-0066-00		Silicon	1N3194		
VR870	152-0212-00		Zener	1N936	500 mW, 9 V, 5% TC	

Transistors

Q810	151-0224-00		Silicon	2N3692		
Q815	151-1005-00		Silicon	FET		
Q825	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q826	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q830	*151-0183-00		Silicon	Selected from 2N2192		
Q840	151-0224-00		Silicon	2N3692		
Q845	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q846	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q850	*151-0183-00		Silicon	Selected from 2N2192		
Q860	151-0224-00		Silicon	2N3692		
Q875	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q876	*151-0192-00		Silicon	Replaceable by MPS 6521		
Q880	*151-0183-00		Silicon	Selected from 2N2192		

ResistorsResistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R811	308-0245-00	0.6 Ω	2 W	WW	5%
R813	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R816	315-0101-00	100 Ω	$\frac{1}{4}$ W		5%
R826	315-0222-00	2.2 k Ω	$\frac{1}{4}$ W		5%
R831	315-0222-00	2.2 k Ω	$\frac{1}{4}$ W		5%

POWER SUPPLY Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description		
Resistors (cont)						
R835	321-0219-00		1.87 kΩ	1⁄8 W	Prec	1%
R836	311-0827-00		250 Ω, Var			
R837	321-0237-00		2.87 kΩ	1⁄8 W	Prec	1%
R841	308-0244-00		0.3 Ω	2 W	WW	
R843	315-0101-00		100 Ω	1⁄4 W		5%
R846	315-0222-00		2.2 kΩ	1⁄4 W		5%
R848	315-0821-00		820 Ω	1⁄4 W		5%
R850	315-0390-00		39 Ω	1⁄4 W		5%
R852	315-0392-00		3.9 kΩ	1⁄4 W		5%
R855	321-0171-00		590 Ω	1⁄8 W	Prec	1%
R856	311-0827-00		250 Ω, Var			
R857	321-0237-00		2.87 kΩ	1⁄8 W	Prec	1%
R861	308-0245-00		0.6 Ω	2 W	WW	5%
R864	315-0101-00		100 Ω	1⁄4 W		5%
R870	321-0183-00		787 Ω	1⁄8 W	Prec	1%
R871	315-0471-00		470 Ω	1⁄4 W		5%
R872	315-0181-00		180 Ω	1⁄4 W		5%
R875	315-0122-00		1.2 kΩ	1⁄4 W		5%
R877	315-0621-00		620 Ω	1⁄4 W		5%
R879	315-0101-00		100 Ω	1⁄4 W		5%
R880	315-0150-00		15 Ω	1⁄4 W		5%
R885	321-0215-00		1.69 kΩ	1⁄8 W	Prec	1%
R886	311-0827-00		250 Ω, Var			
R887	321-0195-00		1.05 kΩ	1⁄8 W	Prec	1%
R889	315-0332-00		3.3 kΩ	1⁄4 W		5%

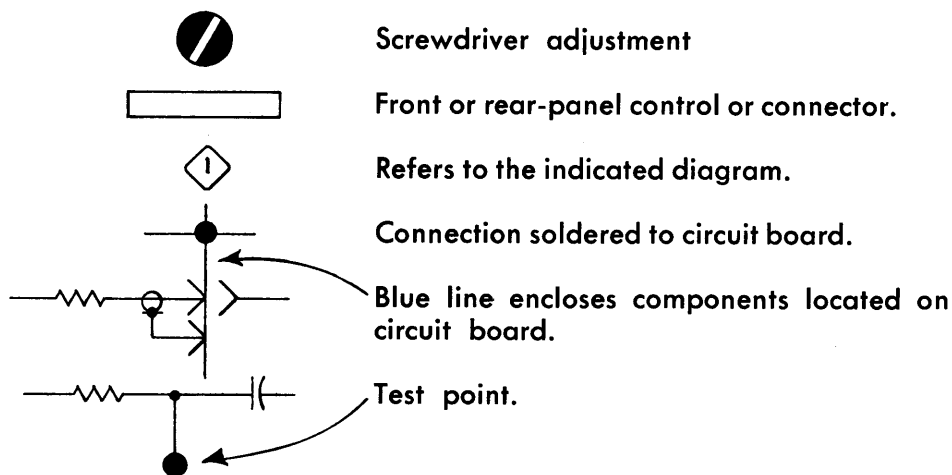
SECTION 8

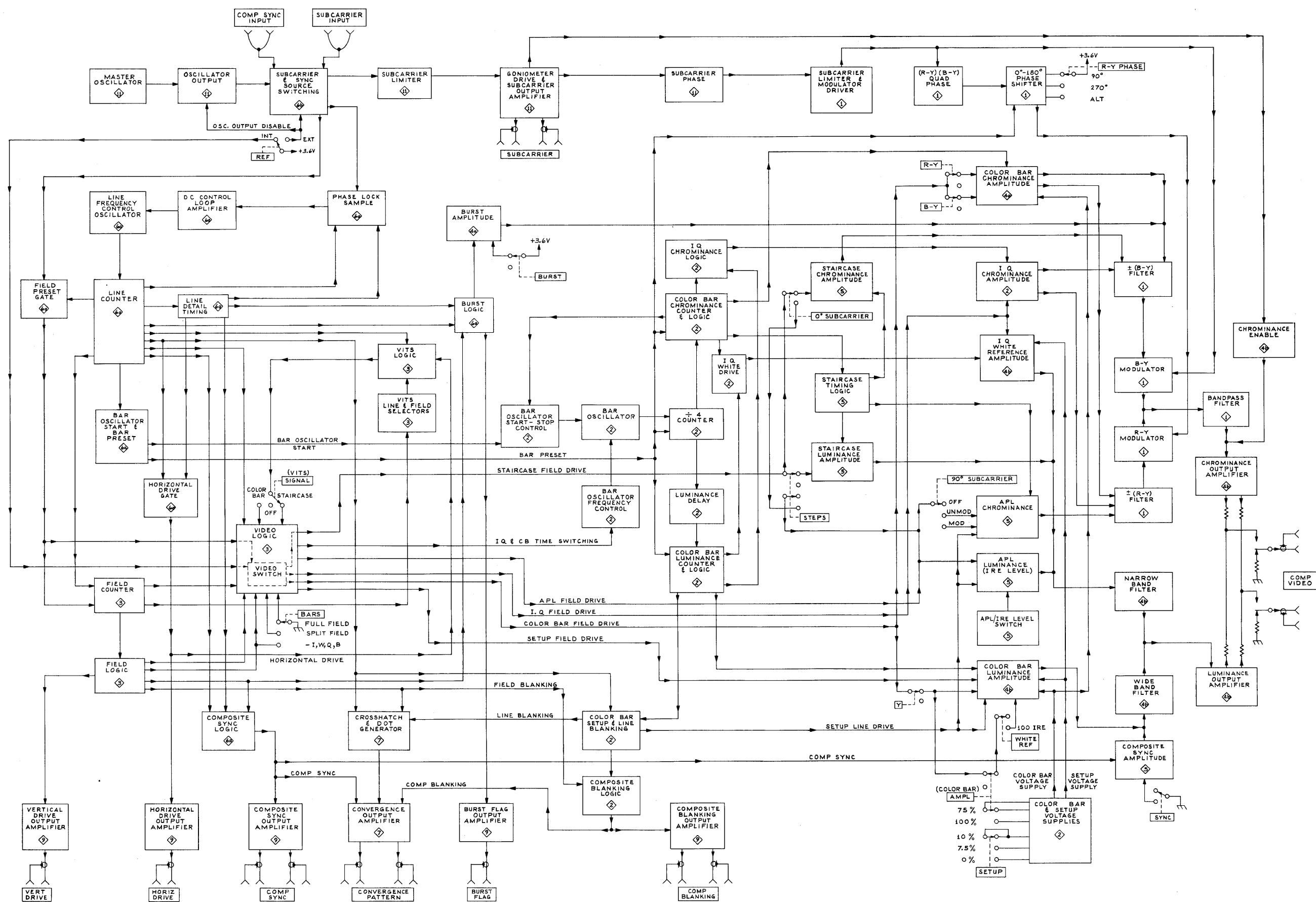
DIAGRAMS

and

MECHANICAL PARTS ILLUSTRATIONS

The following special symbols are used on the diagrams:





VOLTAGE AND WAVEFORM CONDITIONS

DC circuit voltages measured with a digital multimeter with an accuracy of 0.1%; input impedance is greater than 1 kM Ω on the 1.500 volt range and 10 M Ω on the higher ranges. AC voltages measured with a VOM having an accuracy of 3%. All voltages were measured with respect to chassis ground unless noted otherwise.

Waveforms shown are actual photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Each major division represents one cm. Test oscilloscope deflection factor and sweep rate conditions are noted adjacent to each waveform. DC coupling was used to obtain the DC levels that are recorded at the right side of each waveform. These DC levels are located with respect to the graticule line rather than to the waveform. To show time related waveforms, the triggering source for the test oscilloscope is indicated on each diagram.

Voltages and Waveforms on the diagrams (shown in blue) are not absolute and may vary between instruments because of differing component tolerances and internal calibration.

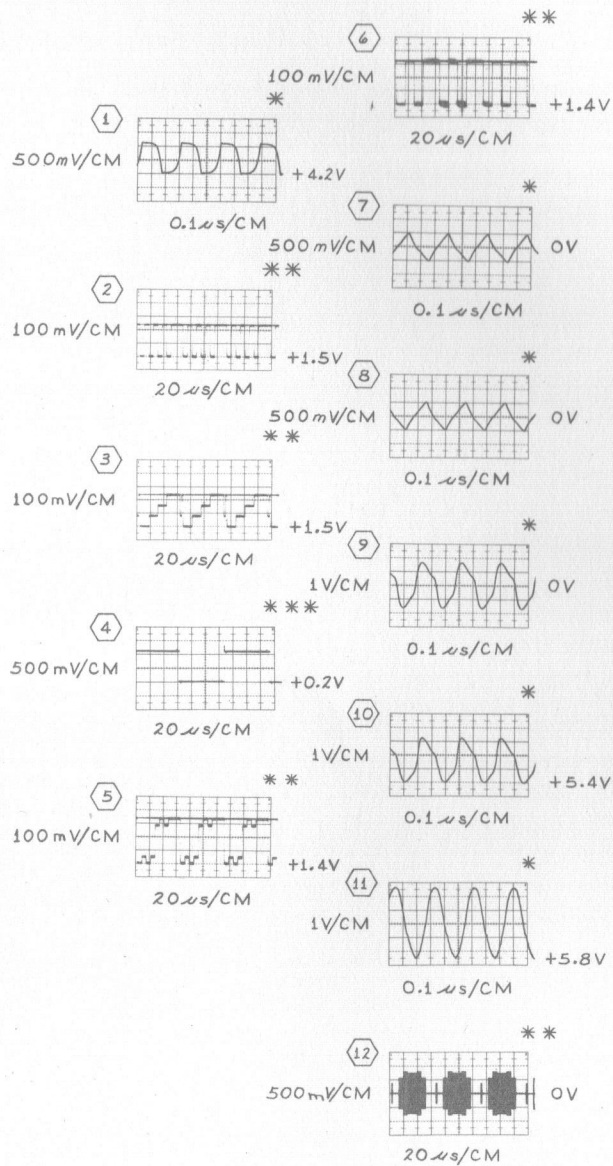
The test oscilloscope used for obtaining the waveform photographs had the following minimum characteristics: Deflection factor, 1 mV/cm to 1 V/cm (10 mV/cm to 10 V/cm with a 10X probe); frequency response, DC to 10 MHz; sweep rates, 0.1 μ s/cm to 10 ms/cm.

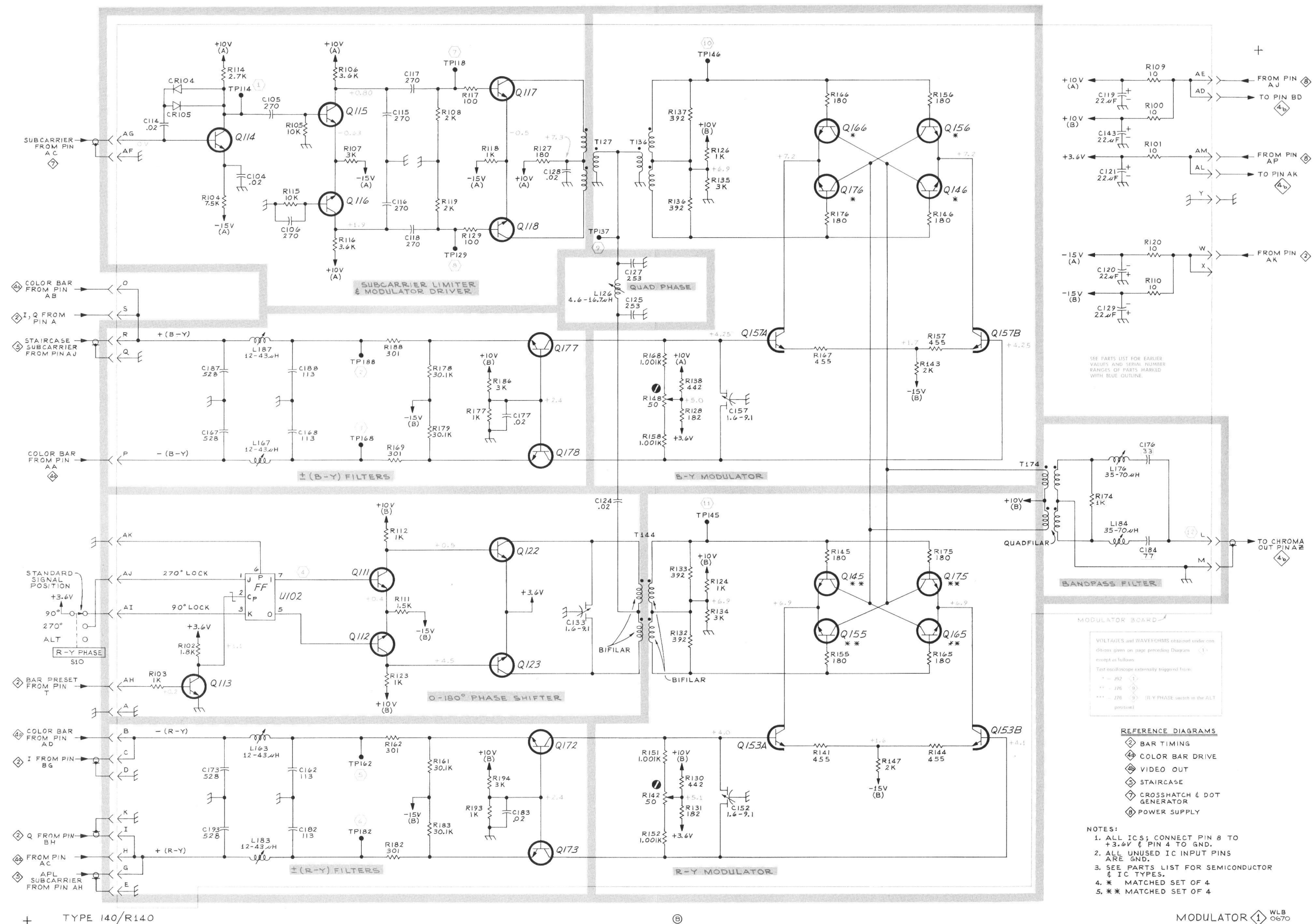
WARNING

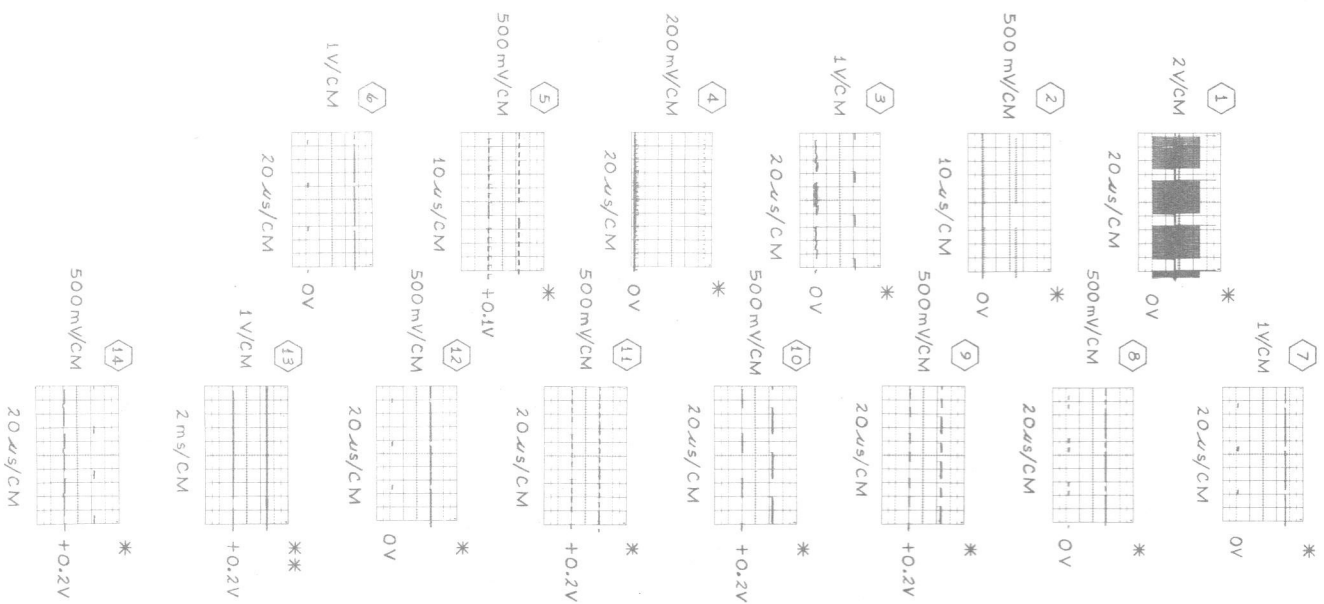
"Ground lugs" are not always at ground potential. Check the schematic before using such connections as a ground for the multimeter, VOM or oscilloscope probe.

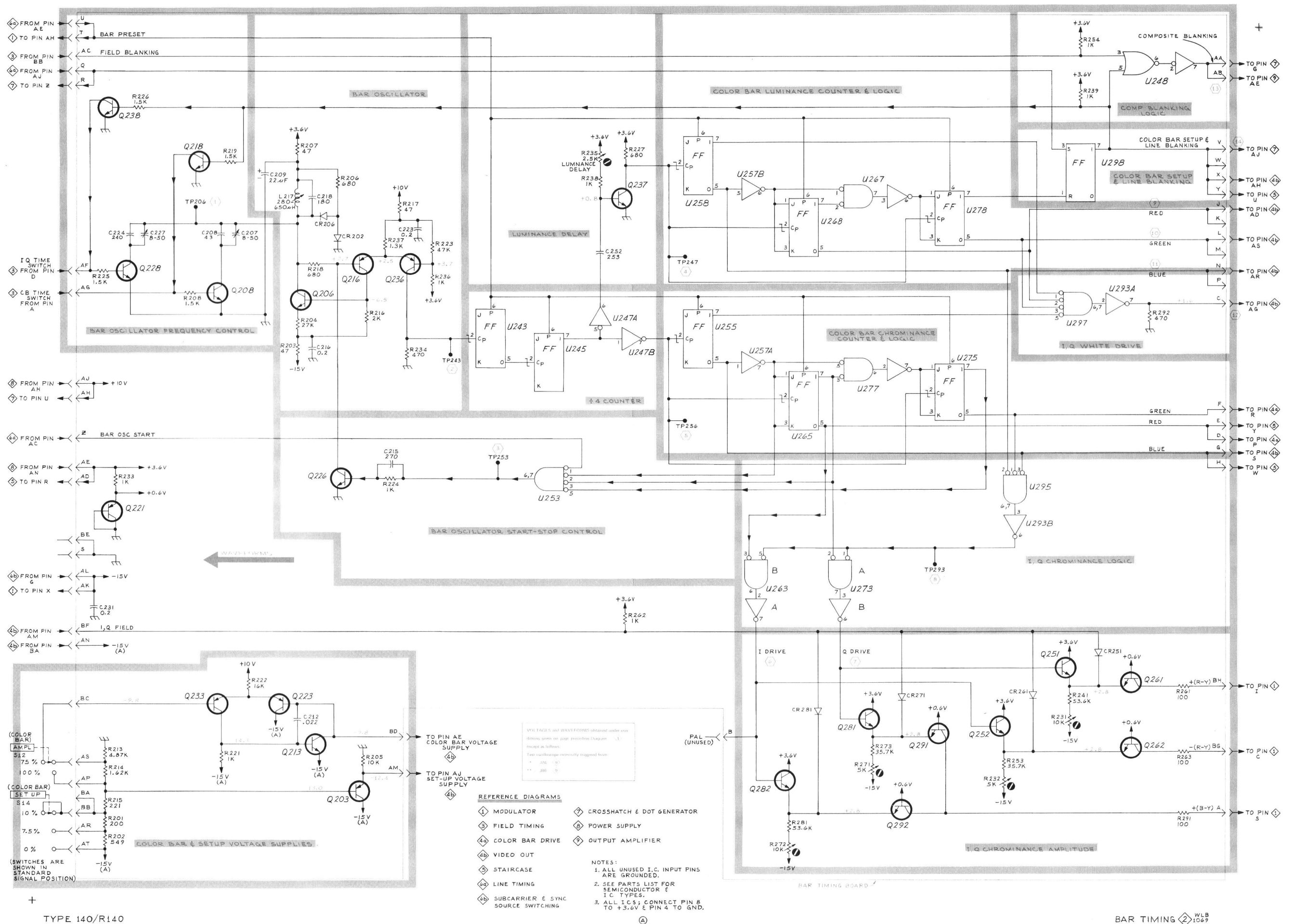
Type R140 control settings are as follows:

COLOR BAR switches	All up
VIDEO switch	Up
MOD. STAIRCASE switches	All up
APL IRE LEVEL	50%
VITS switches	All up
LINE	18
CONVERGENCE switches	All up
SYNCHRONIZATION switches	All up
HORIZ POSITION	Centered
VERT POSITION	Centered
SUBCARRIER PHASE	Centered
POWER	ON
Line Voltage	Design Center (115 VAC) to obtain Power Supply voltage readings.



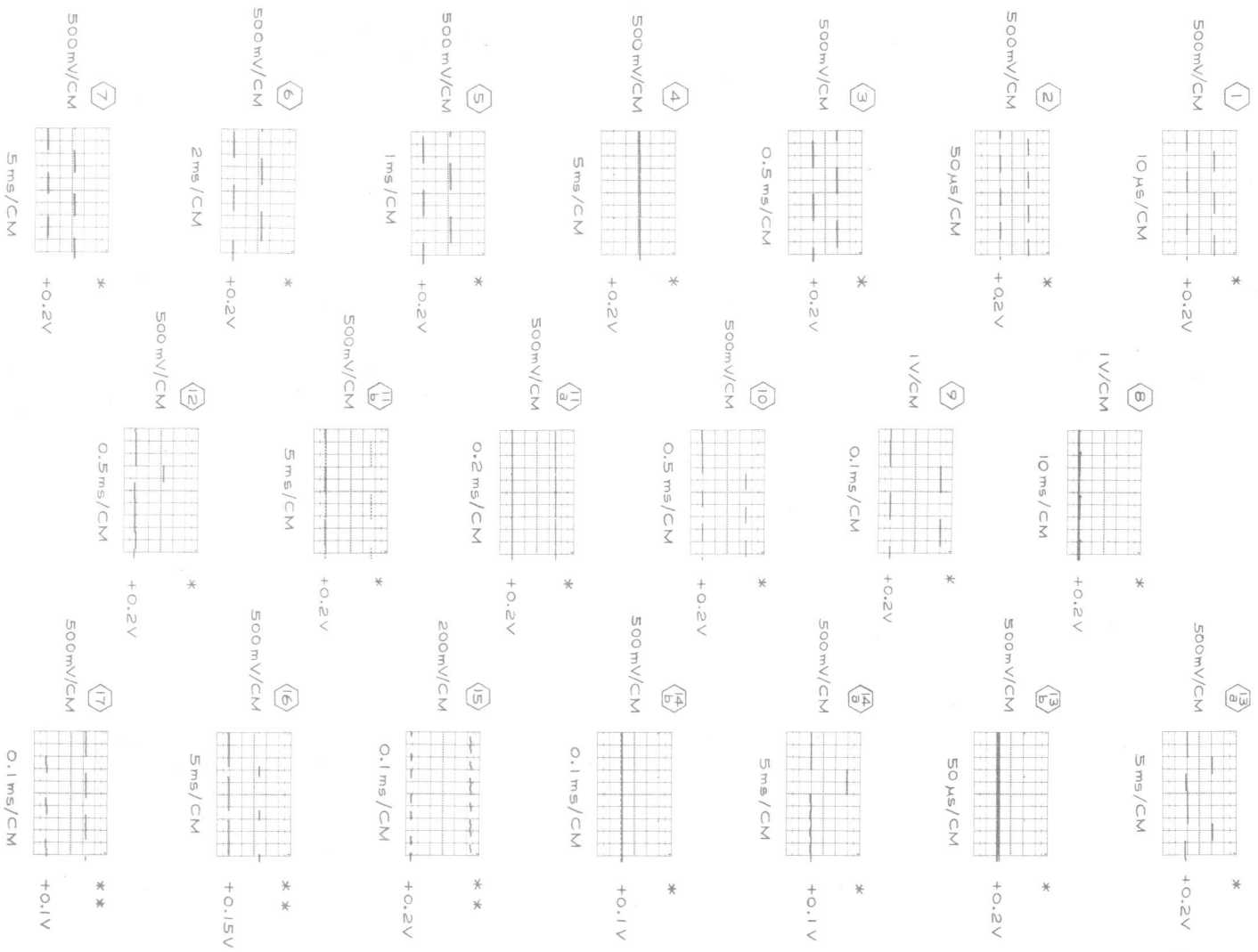






TYPE 140/R140

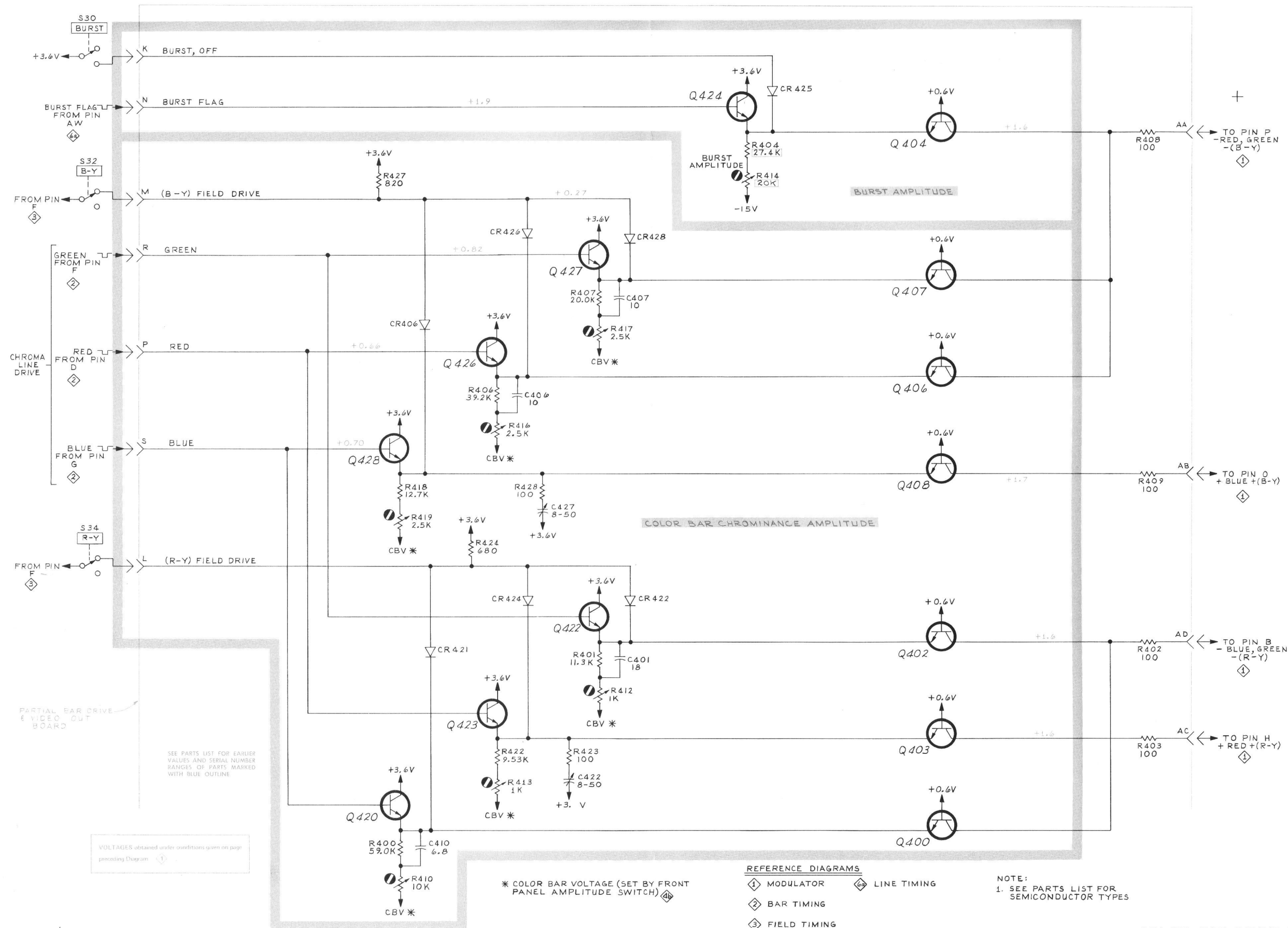
BAR TIMING 2 WLB 1069

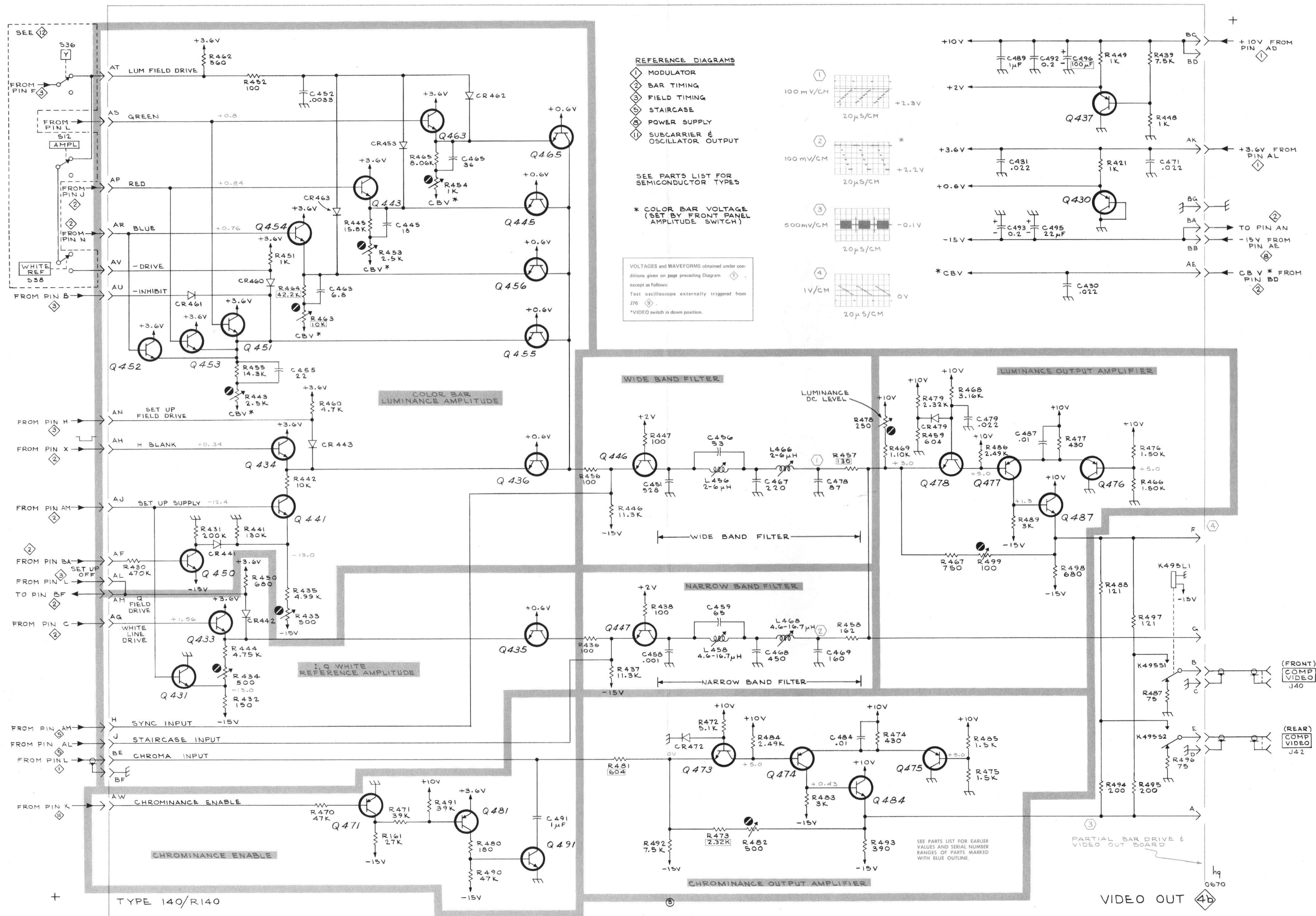




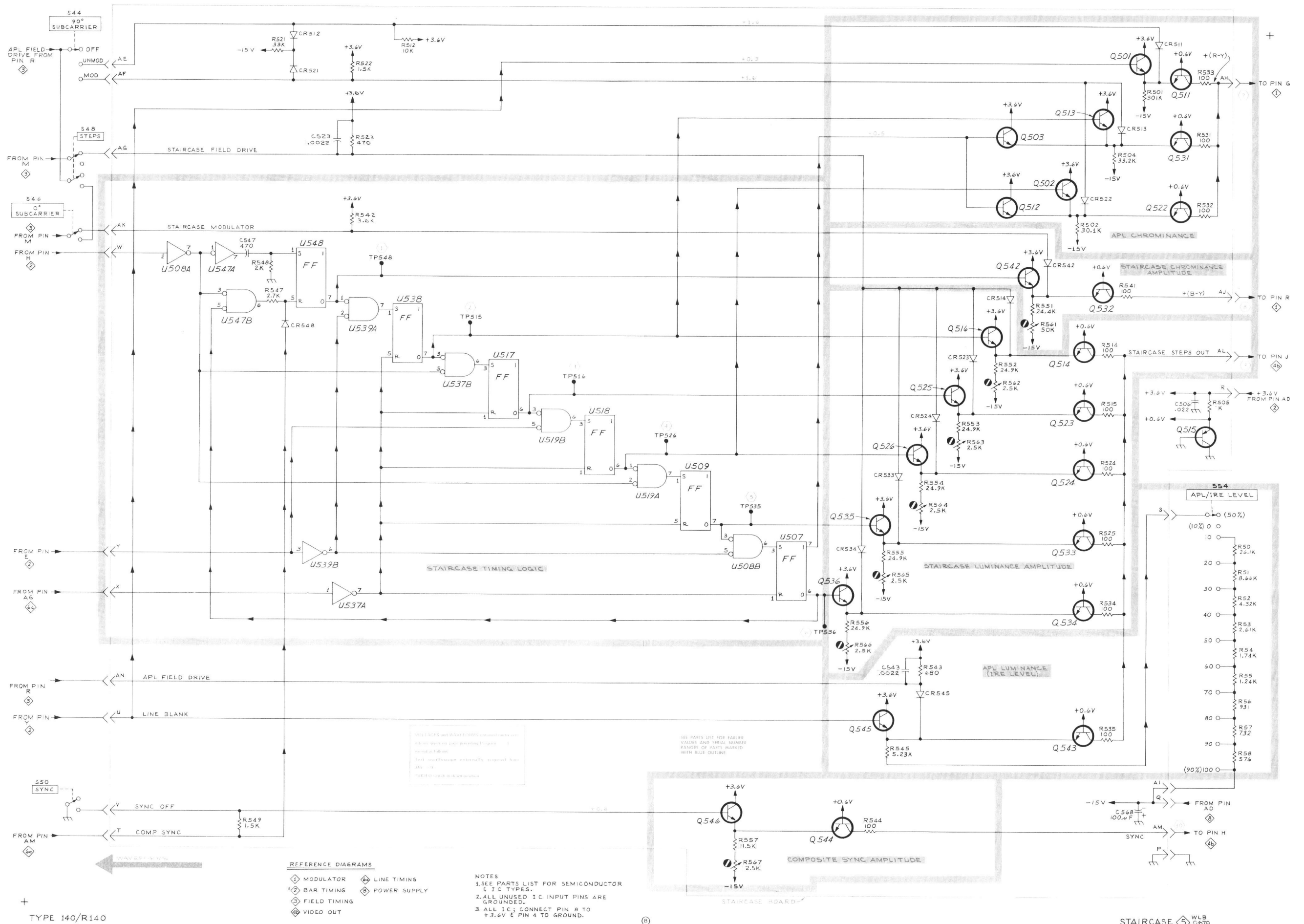
FIELD TIMING

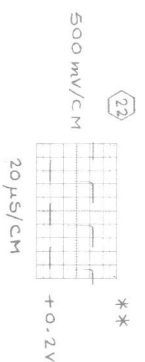
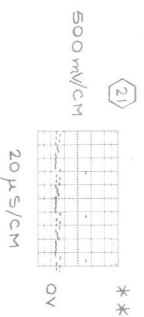
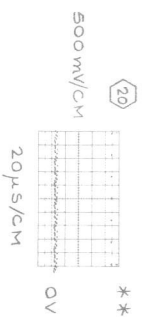
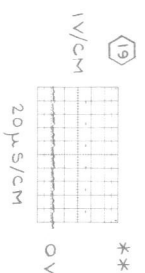
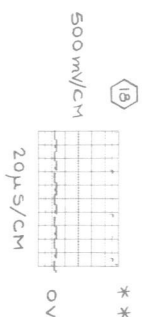
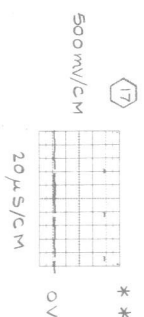
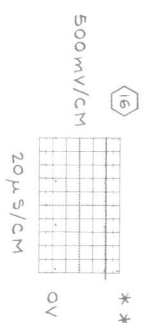
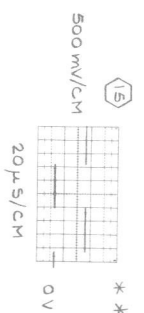
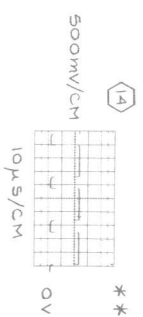
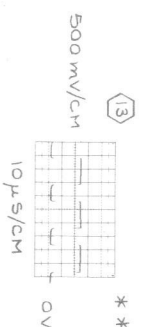
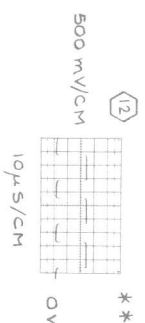
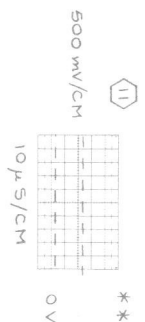
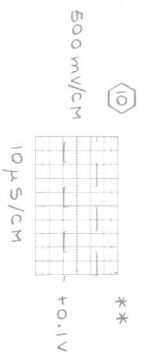
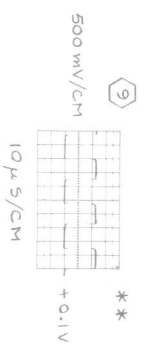
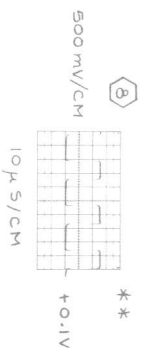
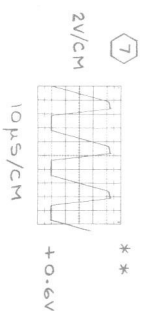
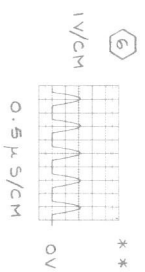
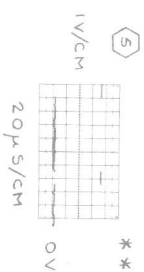
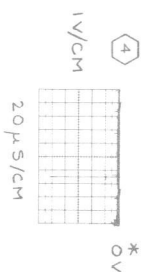
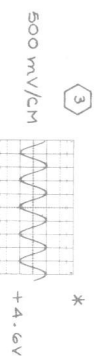
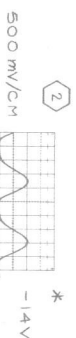
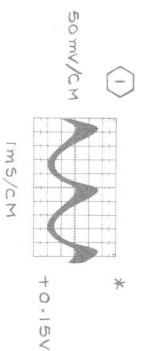
VRS
1069

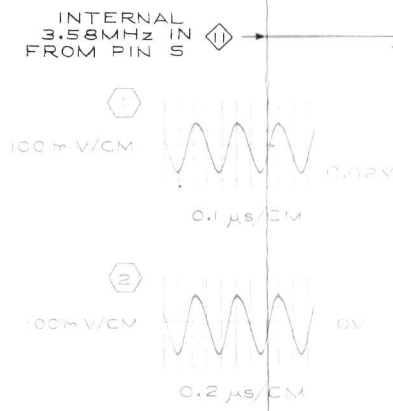
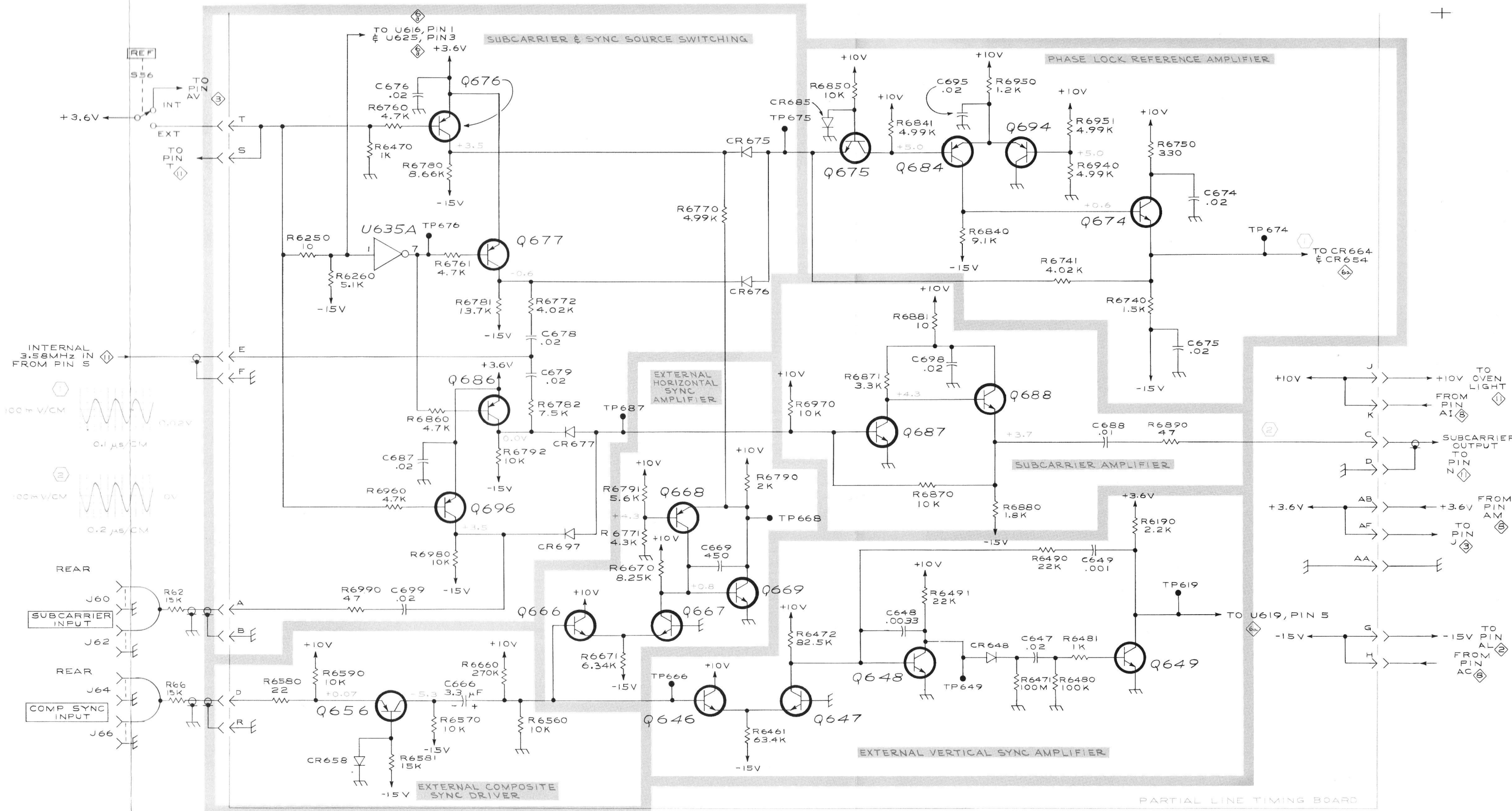












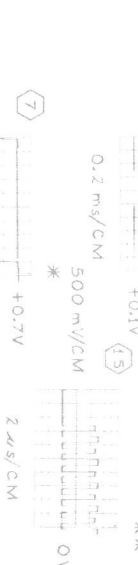
- REFERENCE DIAGRAMS**
- ② BAR TIMING
 - ③ FIELD TIMING
 - ④ LINE TIMING
 - ⑤ POWER SUPPLY
 - ⑥ SUBCARRIER OSCILLATOR & OUTPUT

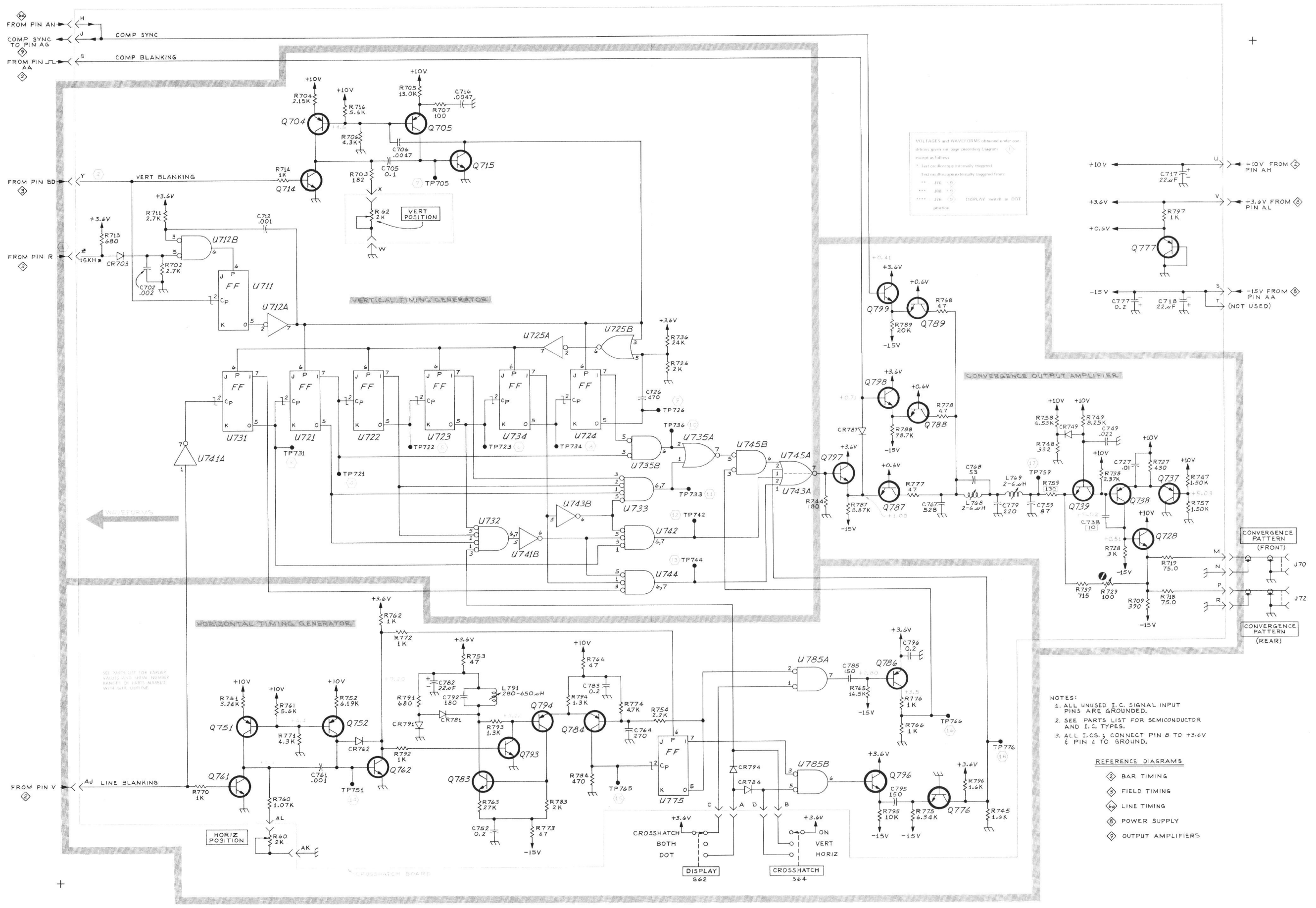
VOLTAGES and WAVEFORMS obtained under conditions given on page preceding Diagram except as follows:
Test oscilloscope internally triggered

- NOTES:**
1. SEE PARTS LIST FOR SEMICONDUCTOR & I.C. TYPES
 2. ALL UNUSED I.C. INPUT PINS ARE GROUND

SUBCARRIER & SYNC SOURCE SWITCHING ⑥b
VR5
1069

TYPE 140/R140

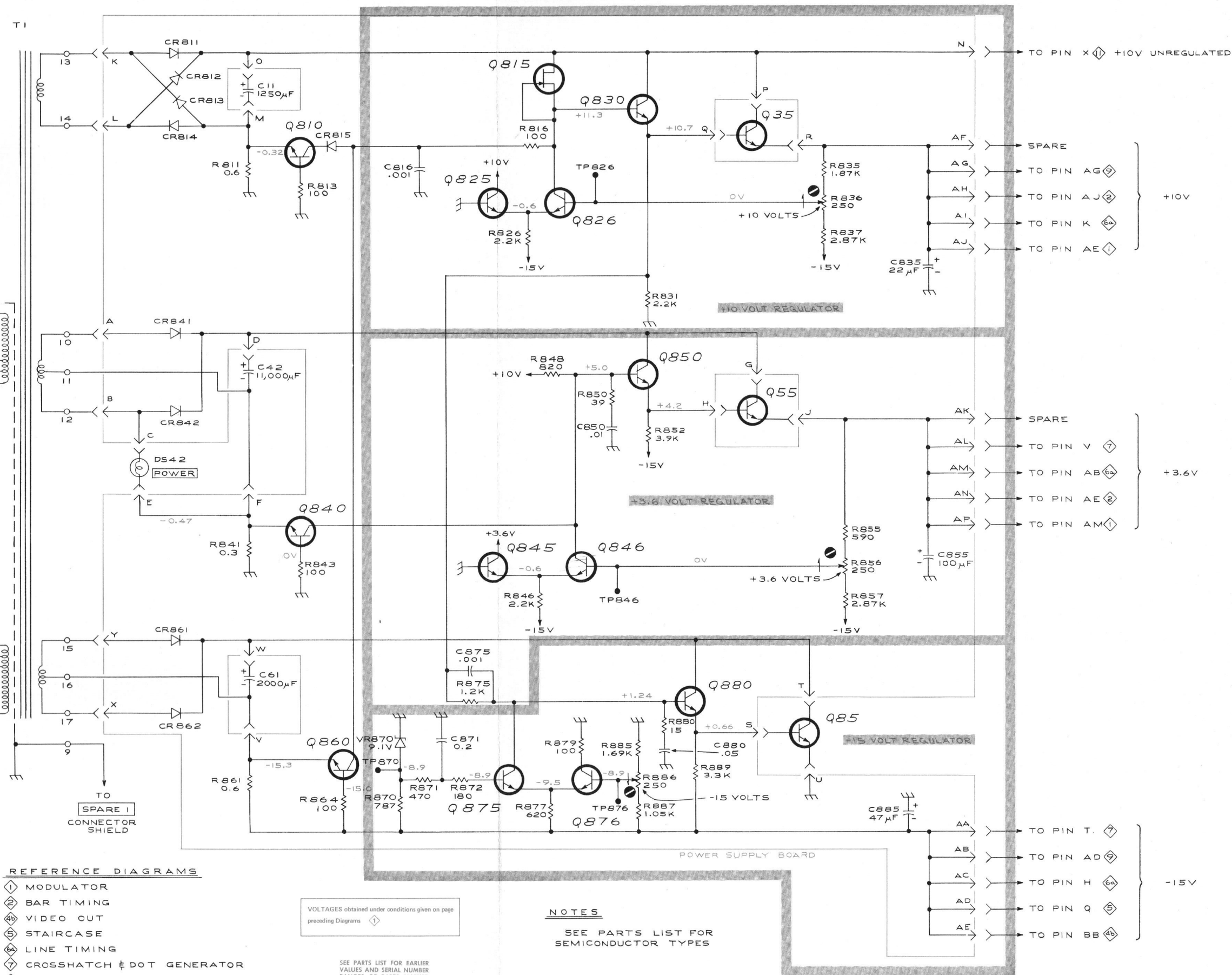
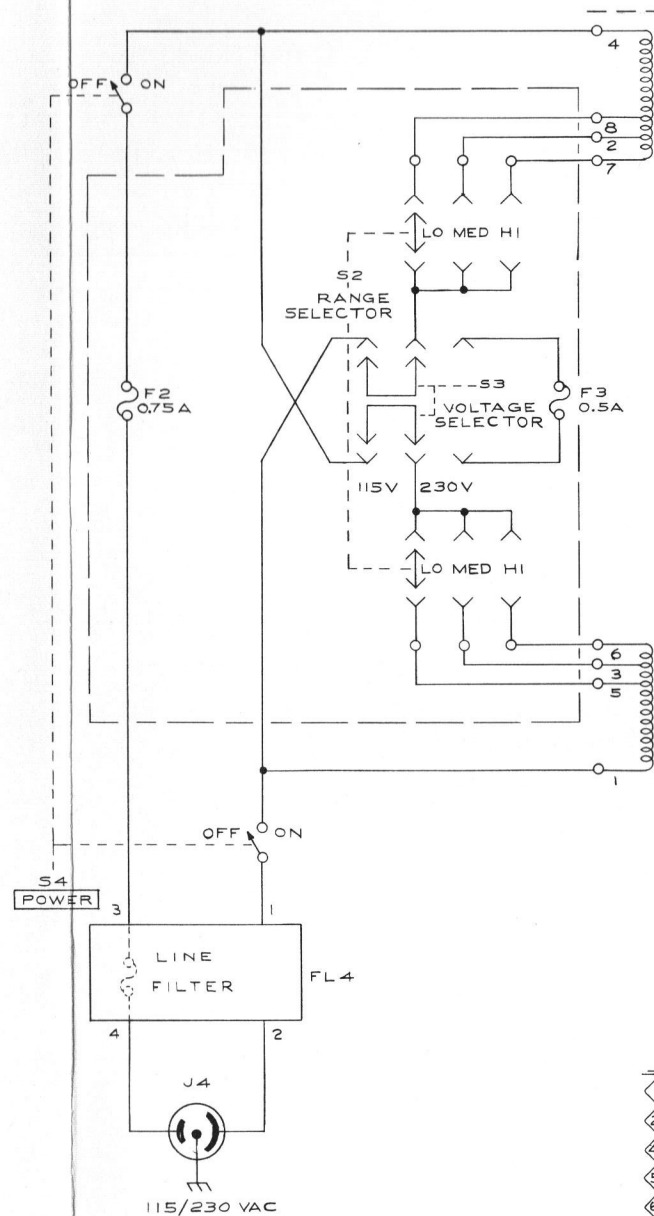
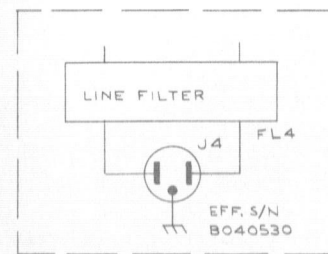




VOLTAGE and WAVEFORMS obtained under conditions given on page preceding Diagram except as follows:
 * Test oscilloscope internally triggered from:
 ** J76 - 9
 *** J80 - 5
 **** J76 - 9 DISPLAY switch in DOT position

- NOTES:
1. ALL UNUSED I.C. SIGNAL INPUT PINS ARE GROUND.
 2. SEE PARTS LIST FOR SEMICONDUCTOR AND I.C. TYPES.
 3. ALL I.C.S.; CONNECT PIN 8 TO +3.6V & PIN 4 TO GROUND.

- REFERENCE DIAGRAMS
- ◇ BAR TIMING
 - ◇ FIELD TIMING
 - ◇ LINE TIMING
 - ◇ POWER SUPPLY
 - ◇ OUTPUT AMPLIFIERS



REFERENCE DIAGRAM

- ① MODULATOR
- ② BAR TIMING
- ④ VIDEO OUT
- ⑤ STAIRCASE
- ⑥ LINE TIMING
- ⑦ CROSSHATCH & DOT GENERATOR
- ⑧ OUTPUT AMPLIFIERS
- ⑨ SUBCARRIER OSCILLATOR & OUTPUT

VOLTAGES obtained under conditions given on page preceding Diagrams ①

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

NOTES

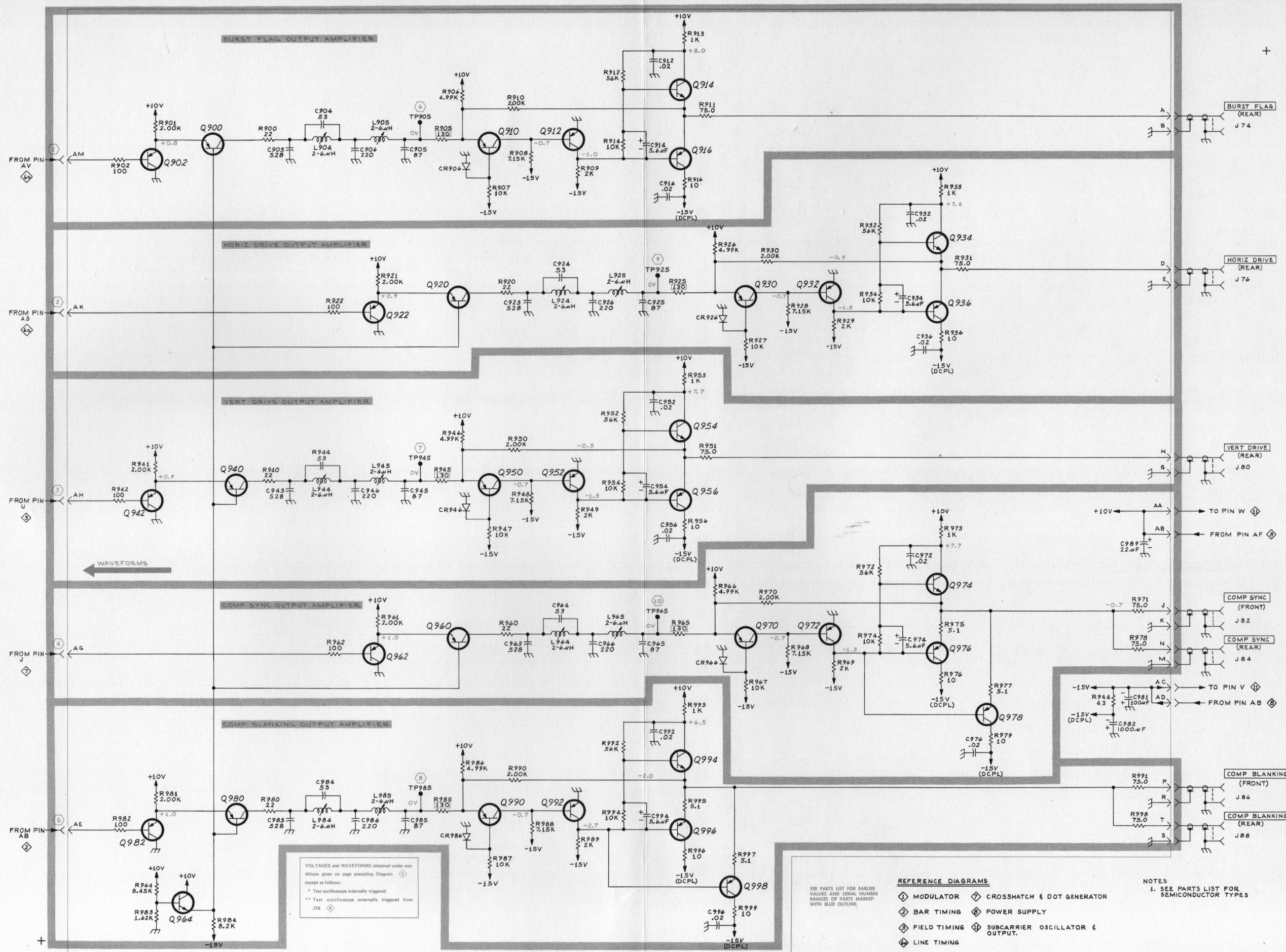
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

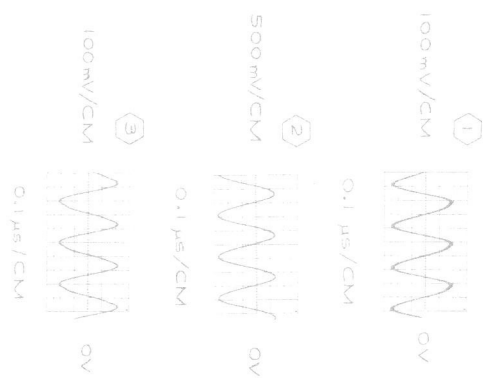
TYPE 140/R140

⑧

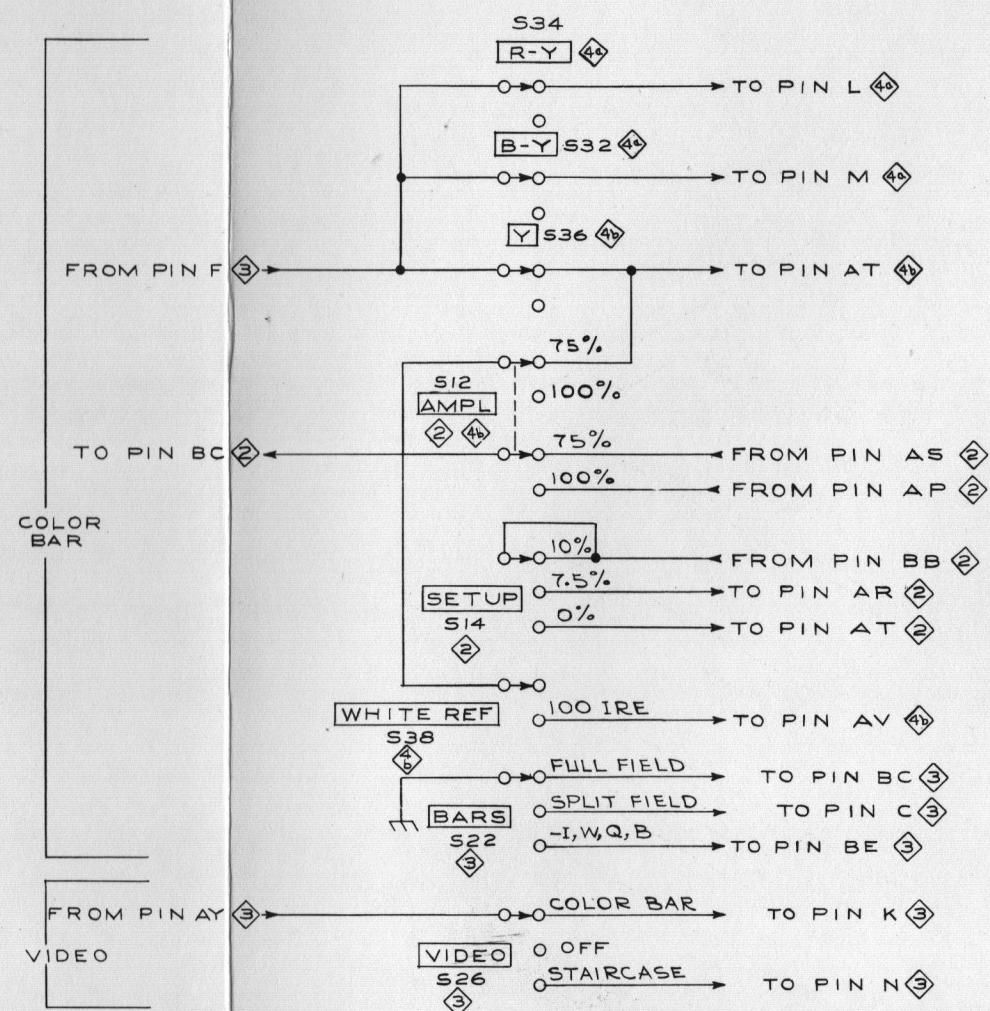
POWER SUPPLY ⑧











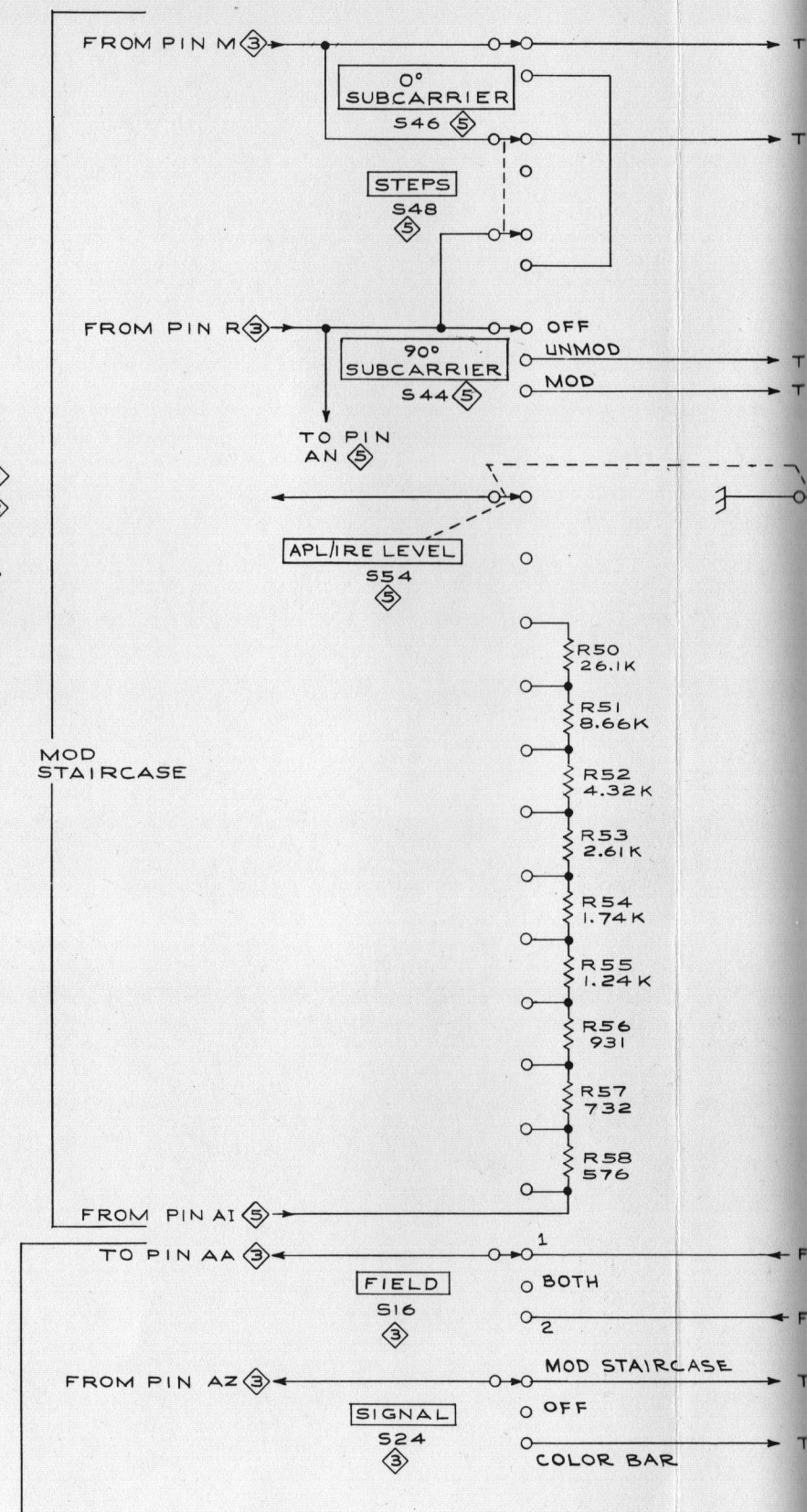
NOTE:

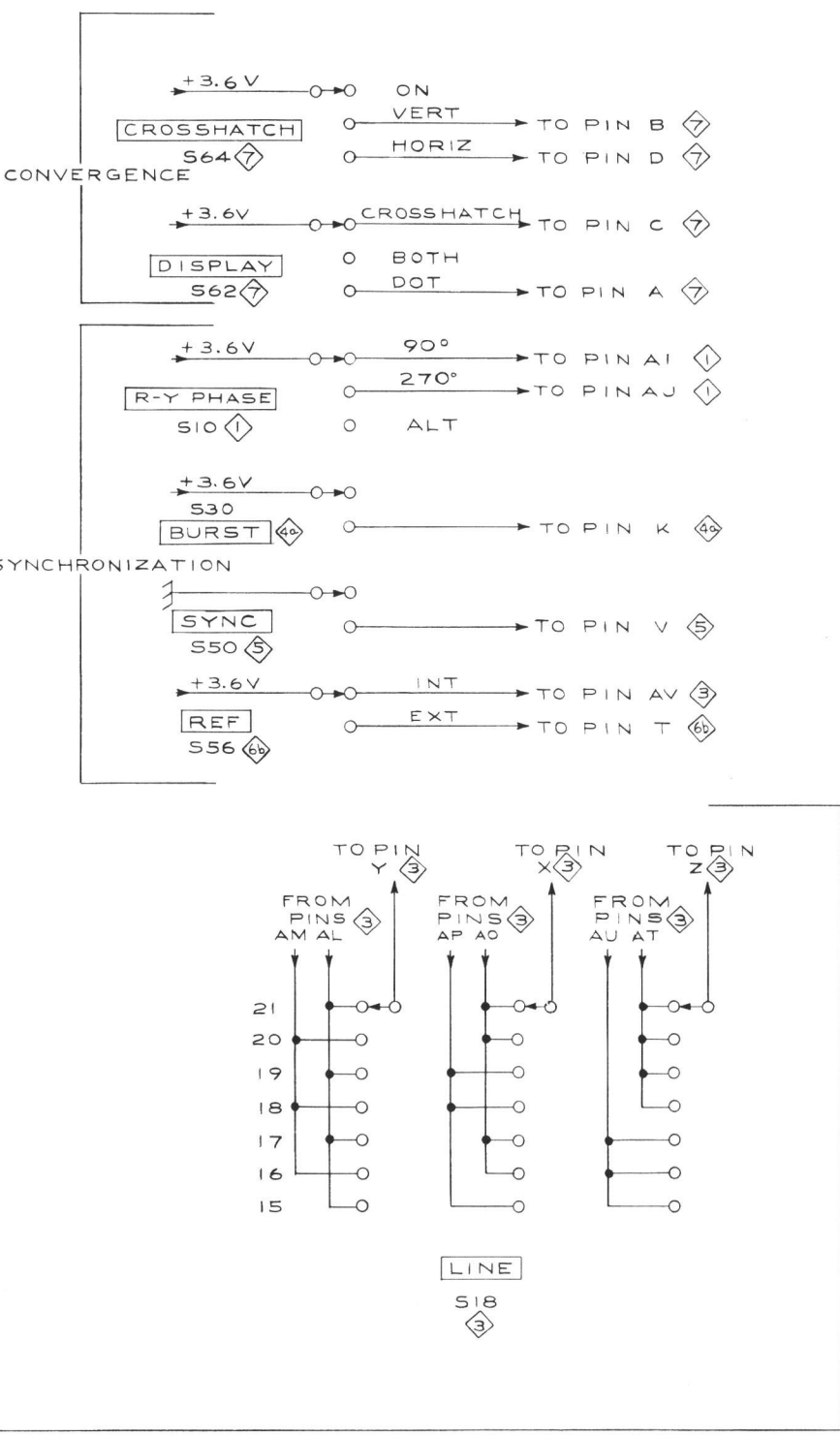
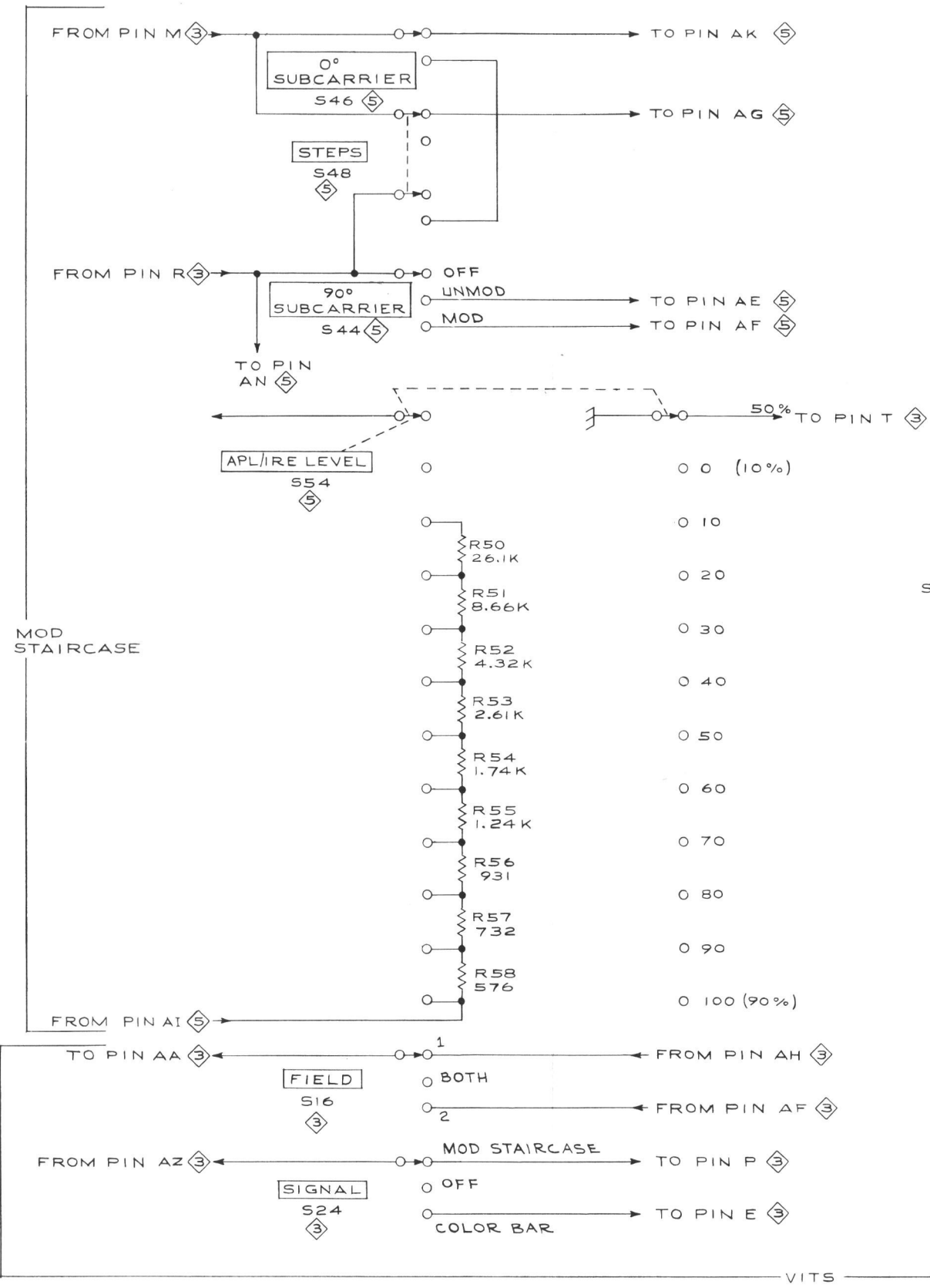
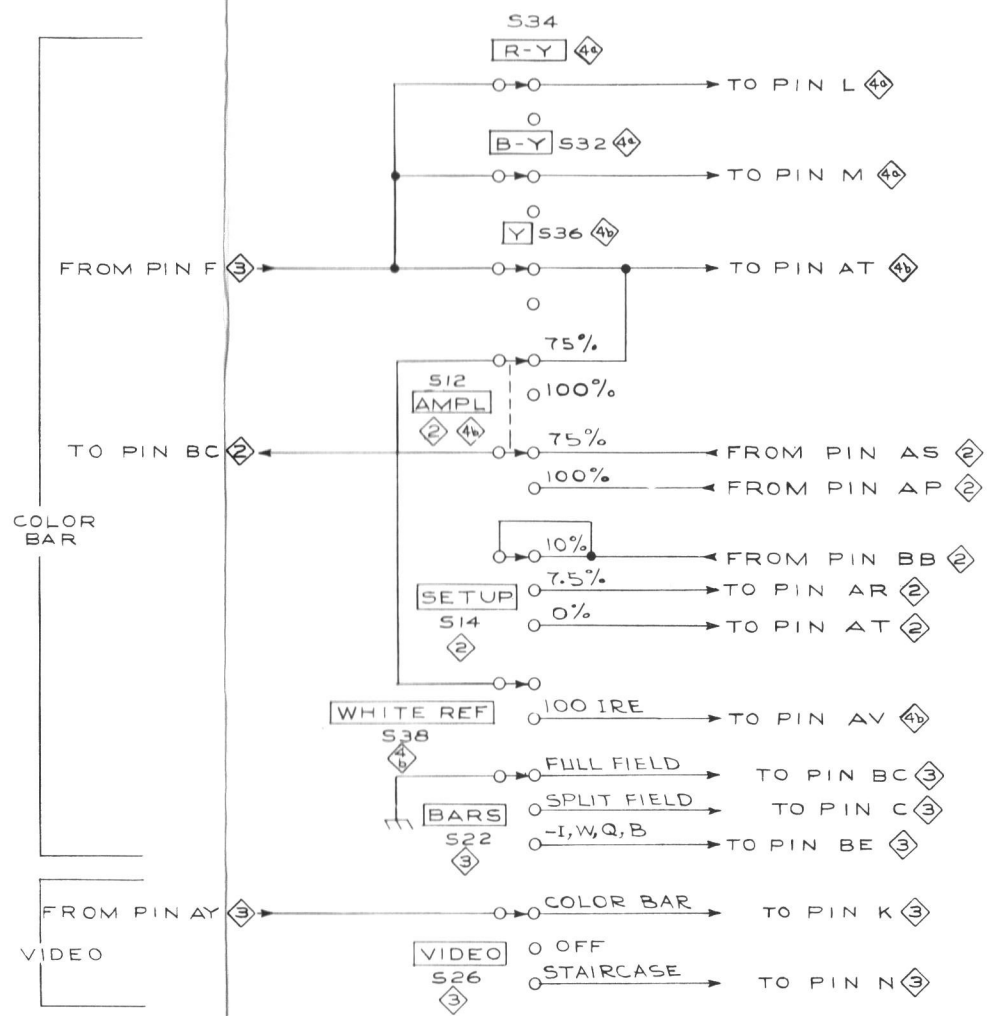
SWITCH CONTACTS LABELED
+3.6V CONNECT TO PIN AS ③
SWITCH CONTACTS LABELED
GROUND (⏏) CONNECT TO PIN AQ ③

REFERENCE DIAGRAMS

- ① MODULATOR
- ② BAR TIMING
- ③ FIELD TIMING
- ④ COLOR BAR TIMING
- ⑤ VIDEO OUTPUT
- ⑥ STAIRCASE
- ⑦ LINE TIMING
- ⑧ CROSSHATCH & DOT GENERATOR

TYPE 140/R140





NOTE:

SWITCH CONTACTS LABELED +3.6V CONNECT TO PIN AS ③

SWITCH CONTACTS LABELED GROUND (⏏) CONNECT TO PIN AQ ③

REFERENCE DIAGRAMS

① MODULATOR

② BAR TIMING

③ FIELD TIMING

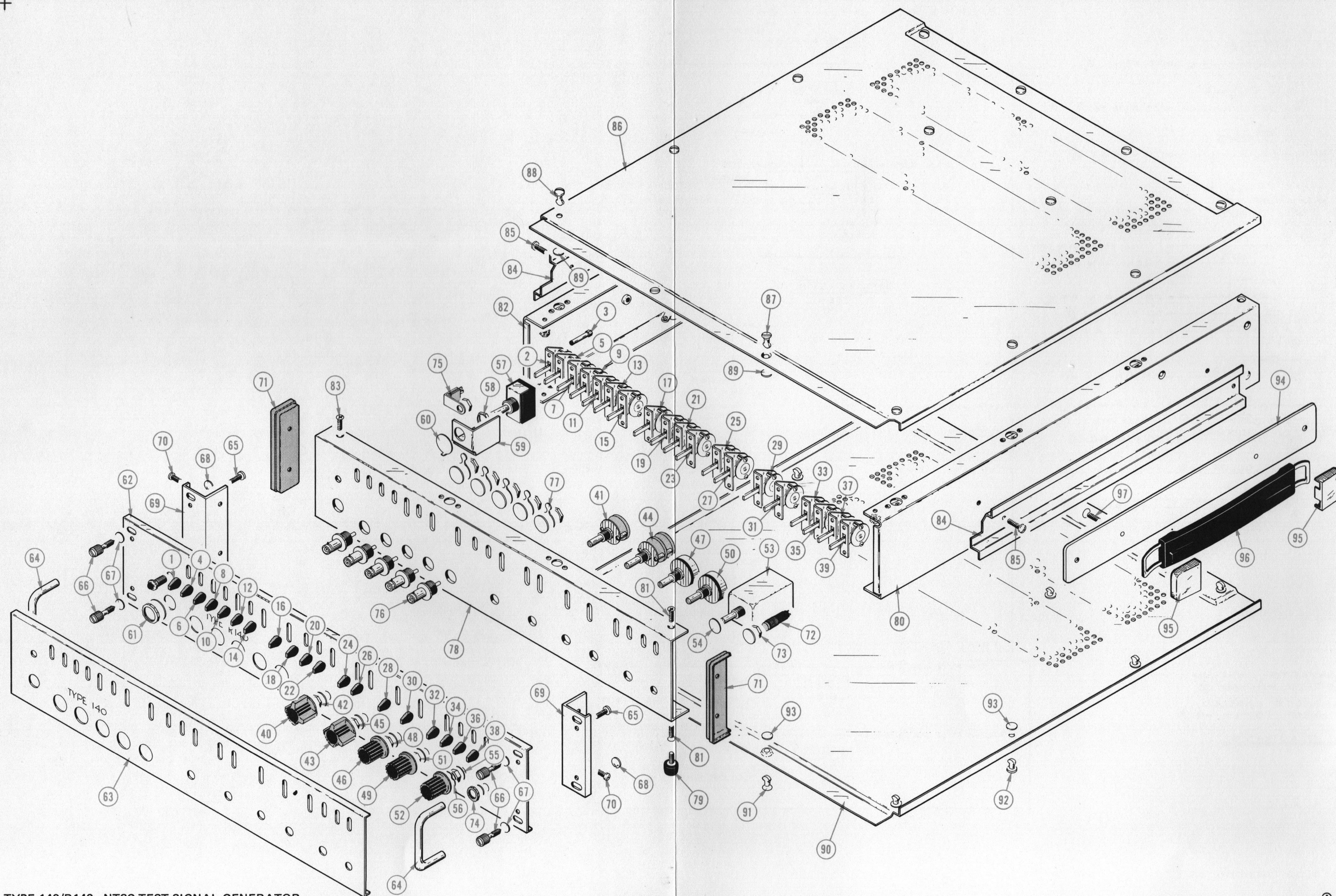
④ COLOR BAR TIMING

⑤ VIDEO OUTPUT

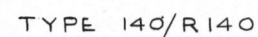
⑥ STAIRCASE

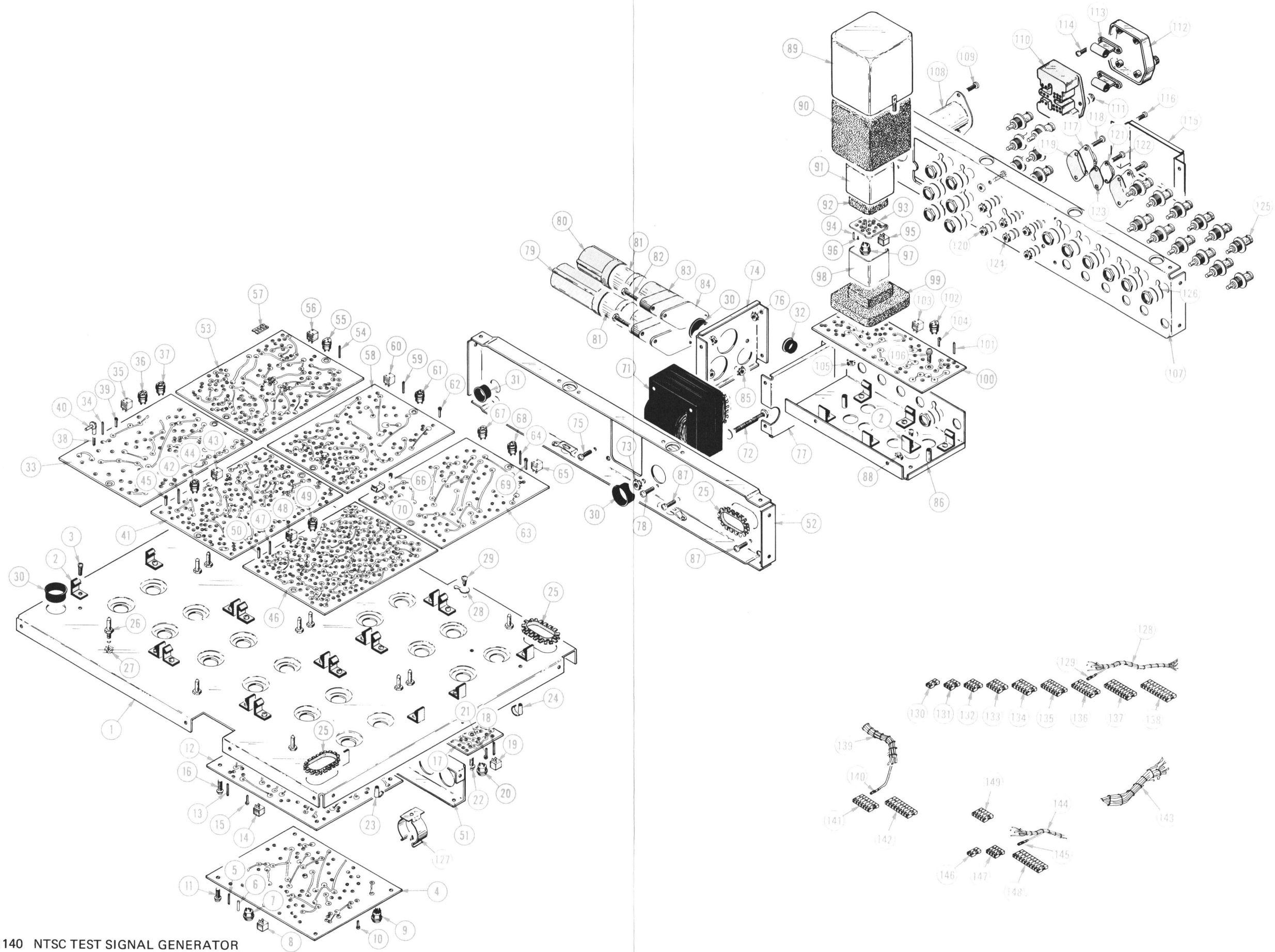
⑦ LINE TIMING

⑧ CROSSHATCH & DOT GENERATOR

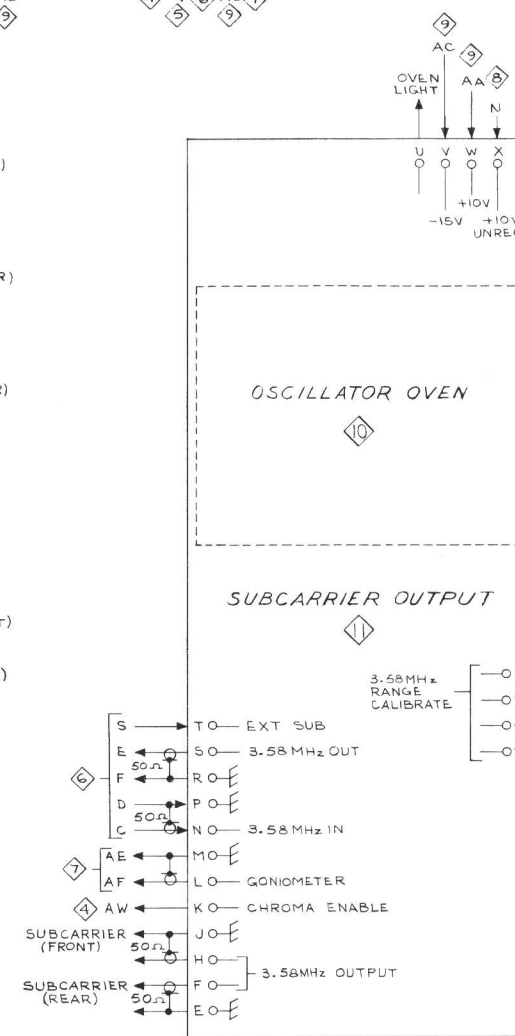
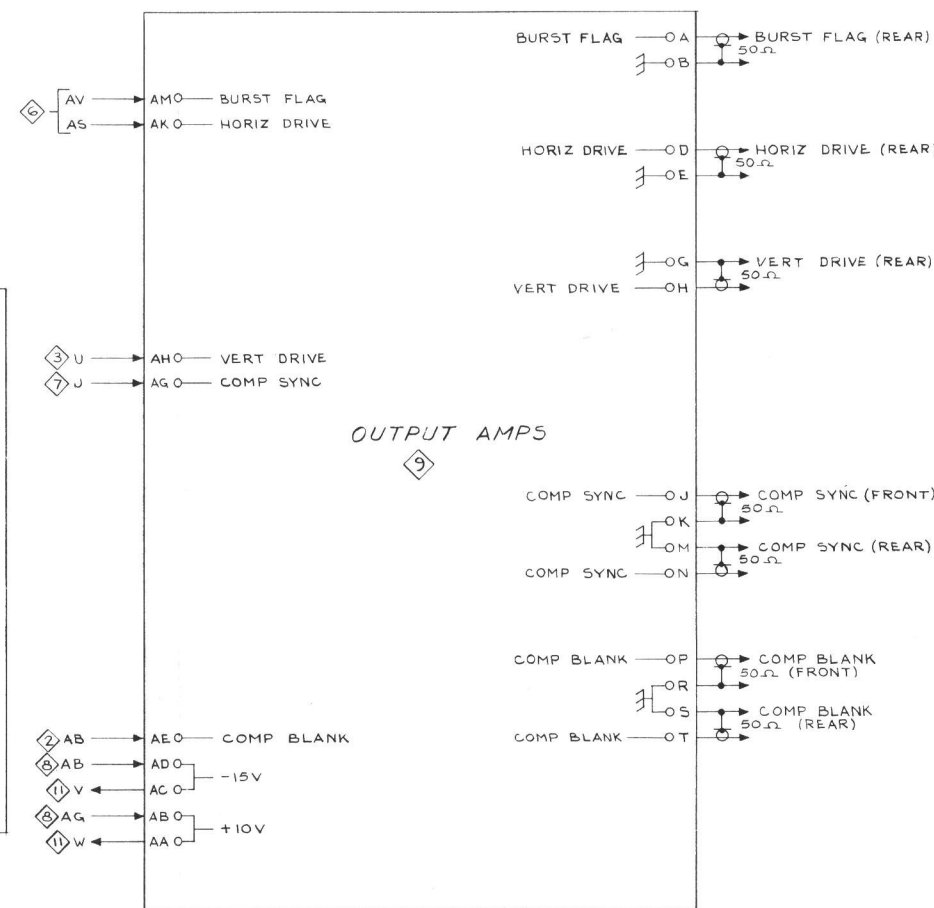
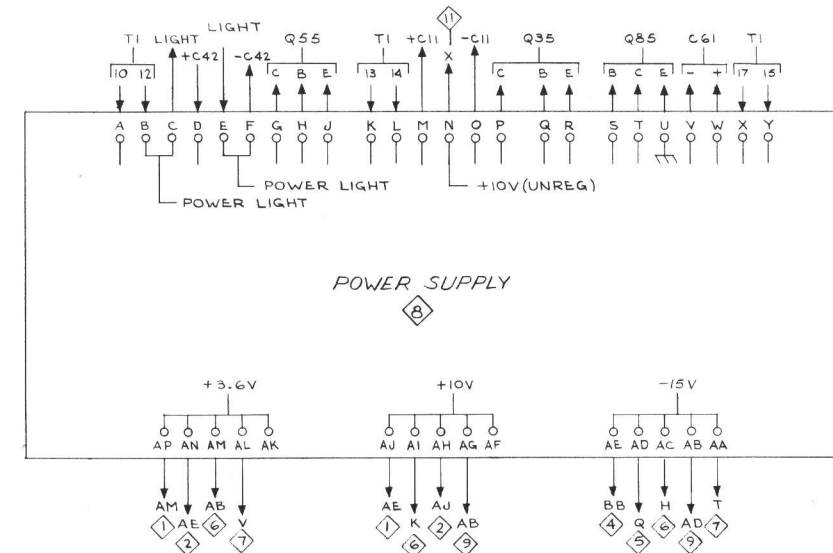
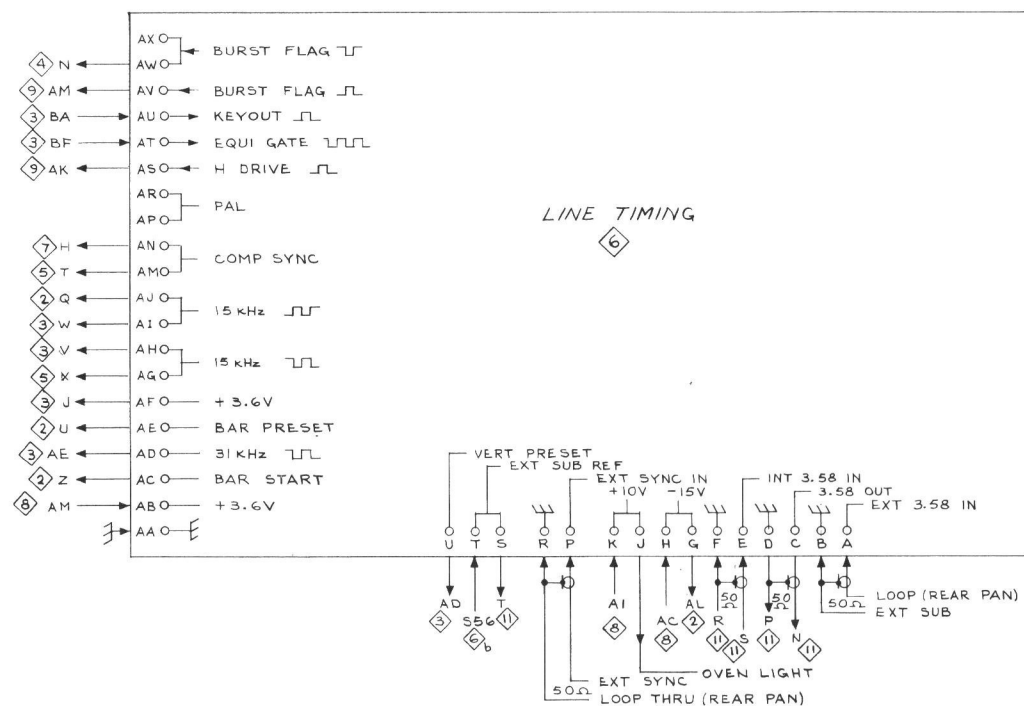
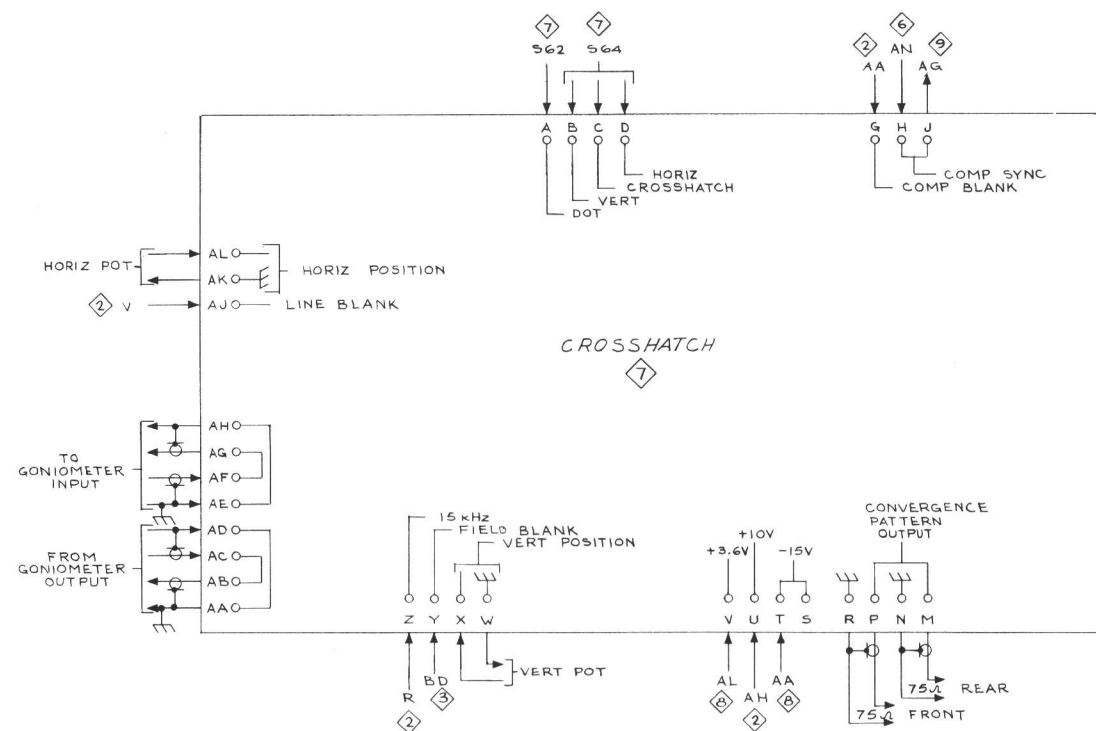


TYPE 140/R140 NTSC TEST SIGNAL GENERATOR





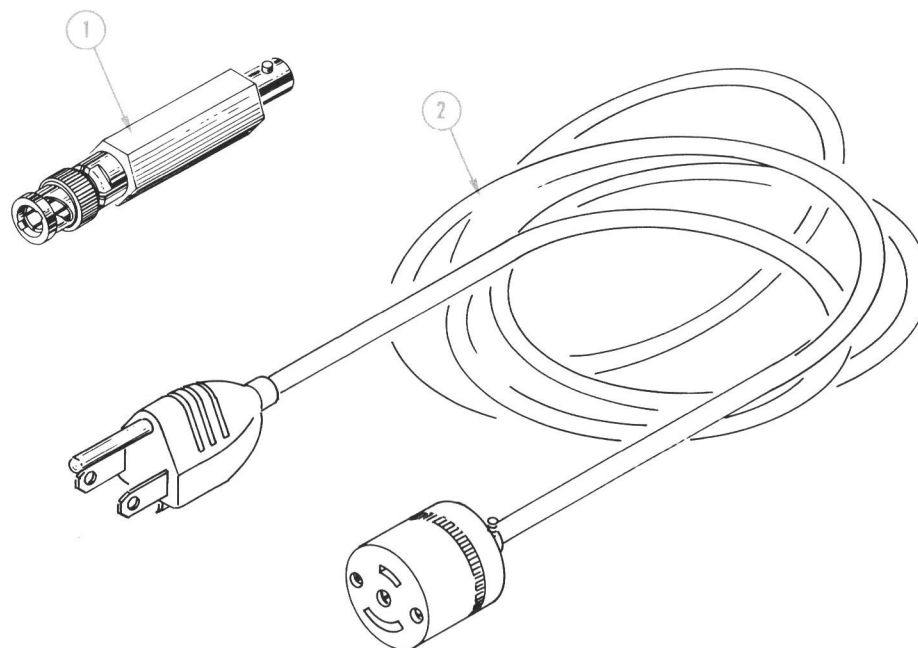
TYPE 140/R140 NTSC TEST SIGNAL GENERATOR



TYPE 140/R140

BOARD INTERCONNECTION DIAGRAM (B) 1069

+



ⓑ+

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Qty					Description
				1	2	3	4	5	
3-1	011-0103-02			1					TERMINATION, 75 Ω , BNC
-2	161-0036-00			1					CABLE ASSEMBLY, power, 3 wire, 7 1/2 feet long
	351-0195-00 ⁵			1					TRACK, slide, stationary & intersection (pair, not shown)
	070-0944-00			2					MANUAL, instruction (not shown)

Ⓐ

⁵Type R140 onlyFIG. 3 ACCESSORIES
TYPE 140/R140 NTSC TEST SIGNAL GENERATOR

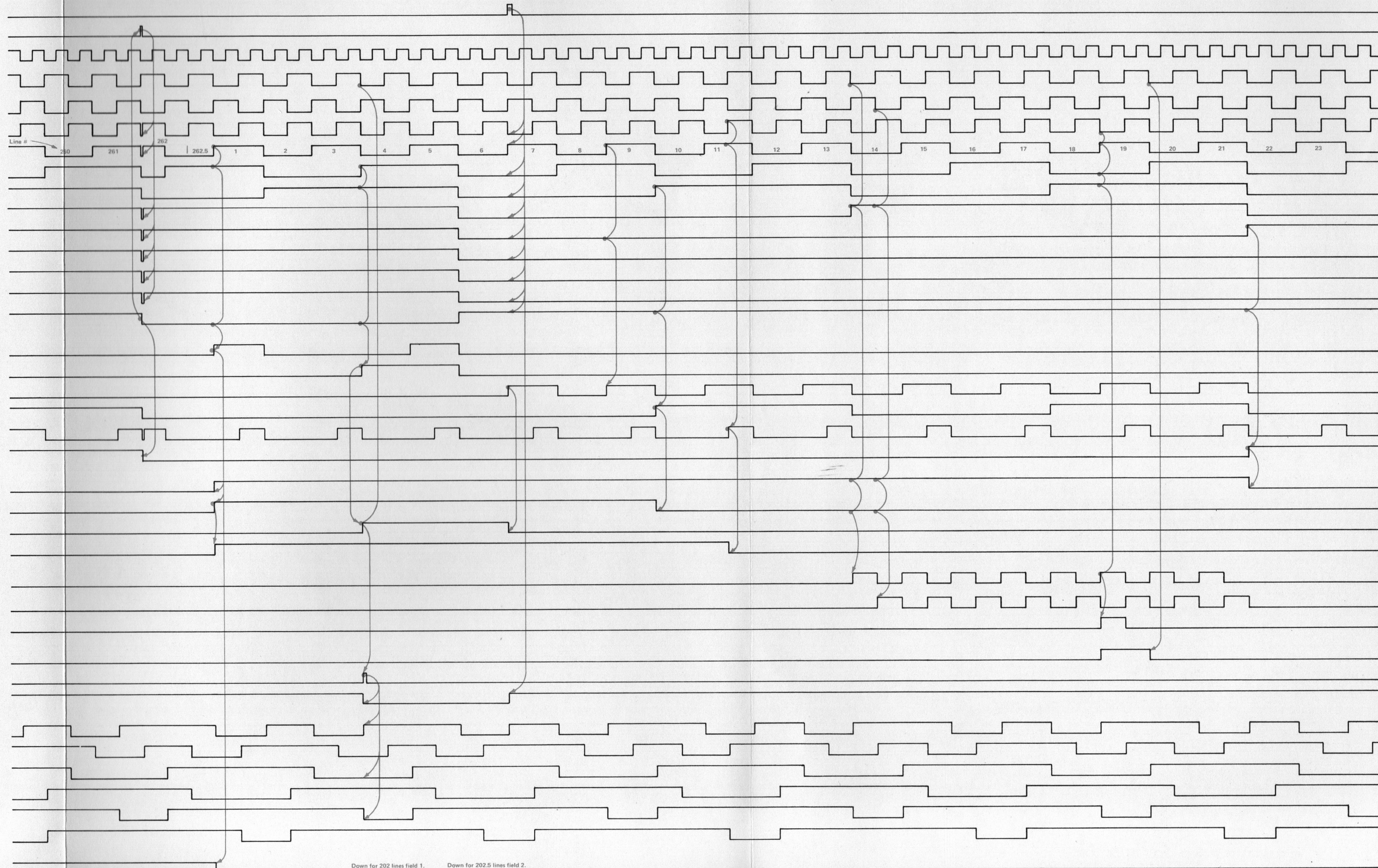
T FIELD)

ld 1

ld 2

9, Field 1)

ync only)



Down for 202 lines field 1. Down for 202.5 lines field 2.

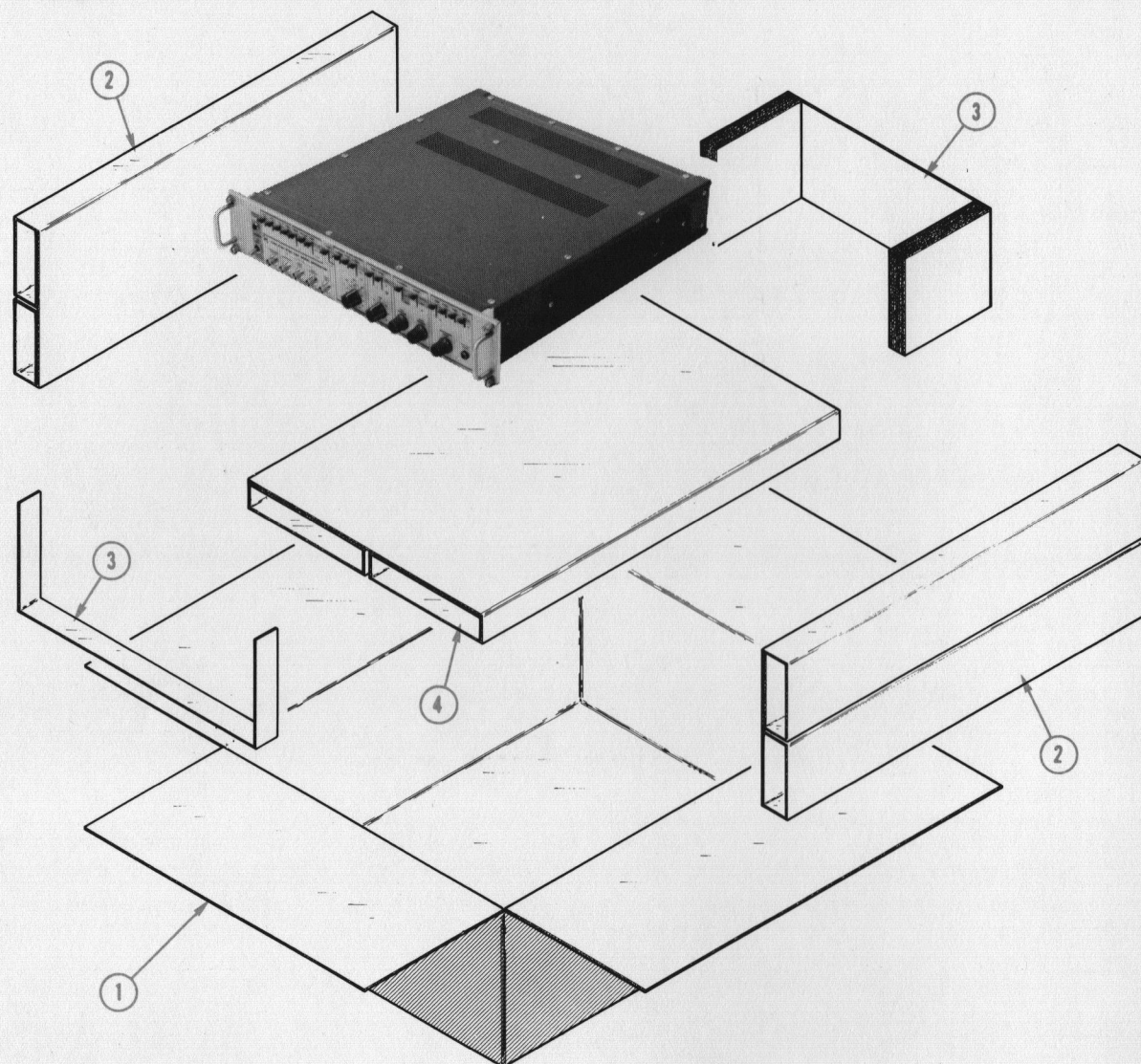
*NOTE: These pulses are not all present during any one period of time, but represent the signal at TP 349 with the VITS LINE and FIELD switches set to each possible selection.

TYPE 140/R140

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CARTON ASSEMBLY
(Part No. 065-0120-00)

INNER



OUTER

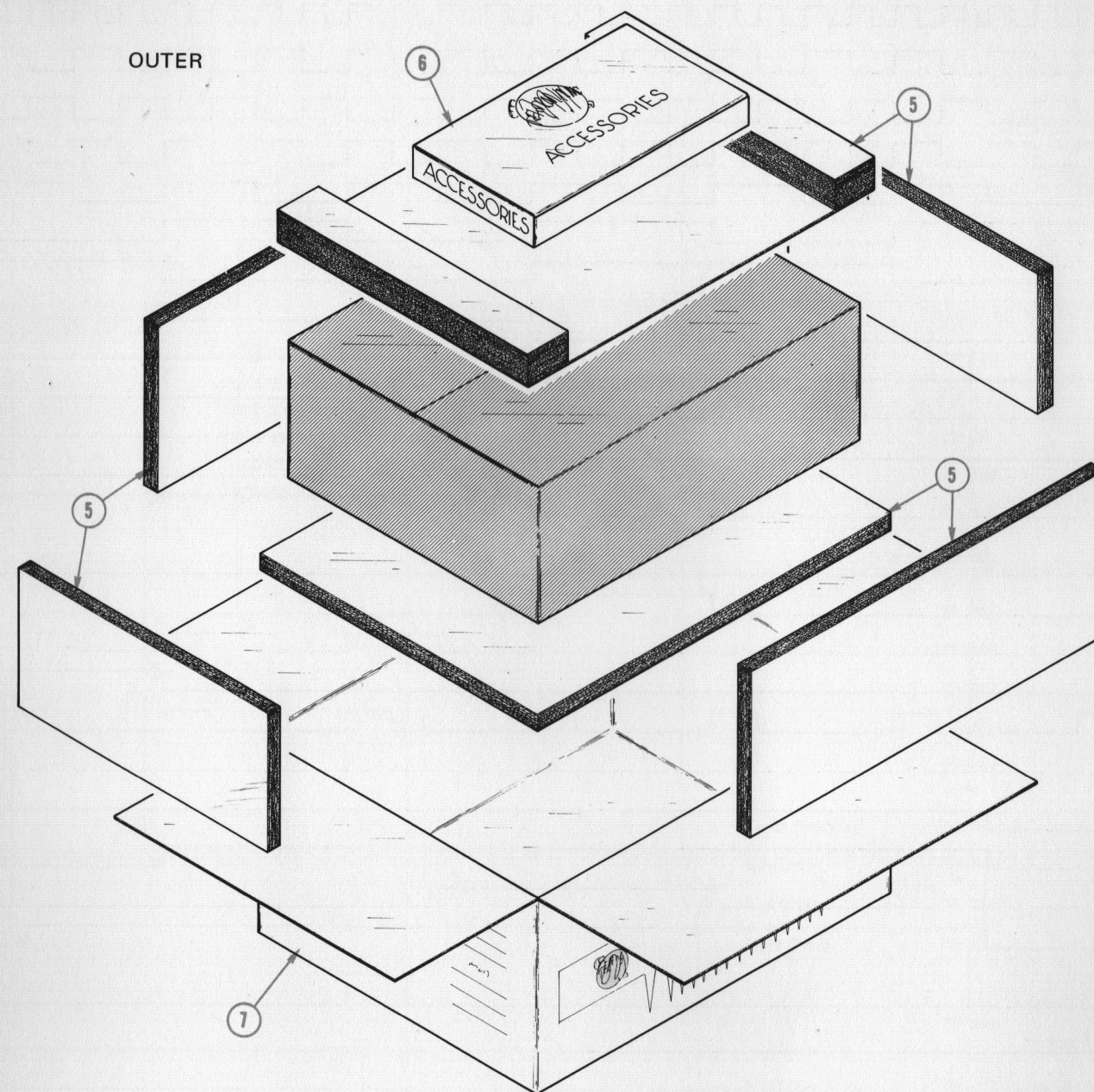


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q t y	Description
	065-0120-00			1	ASSEMBLY, carton
	- - - - -			-	assembly includes
1	004-0460-00			1	CARTON, inner
2	004-0360-00			1	PAD SET, 2 piece
3	004-0359-00			1	PAD SET, 2 piece
4	004-0357-00			3	PAD

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q t y	Description
-5	004-0361-00			1	PAD SET, 6 piece
-6	004-0462-00			1	CARTON, accessory
-7	004-0461-00			1	CARTON, outer

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS ILLUSTRATIONS

Title	Location (reverse side of)
Figure 1 Front & Cabinet	Switching Diagram
Figure 2 Chassis & Rear	Board Interconnecting Diagram (A)
Figure 3 Standard Accessories	Board Interconnecting Diagram (B)
Figure 4 Repackaging	Field Timing Details

SECTION 9

MECHANICAL PARTS LIST

FIGURE 1 FRONT & CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q † y 1 2 3 4 5					Description
1-1	366-0215-02			1					1 KNOB, gray—R-Y
-2	260-0731-00			1					1 SWITCH, lever—R-Y
	- - - - -			-					mounting hardware: (not included w/switch)
-3	220-0413-00			2					2 NUT, switch mounting
-4	366-0215-02			1					1 KNOB, gray—B-Y
-5	260-0731-00			1					1 SWITCH, lever—B-Y
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-6	366-0215-02			1					1 KNOB, gray—Y
-7	260-0731-00			1					1 SWITCH, lever—Y
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-8	366-0215-02			1					1 KNOB, gray—AMPL
-9	260-0664-00			1					1 SWITCH, lever—AMPL
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-10	366-0215-02			1					1 KNOB, gray—SETUP
-11	260-0621-00			1					1 SWITCH, lever—SETUP
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-12	366-0215-02			1					1 KNOB, gray—WHITE REF
-13	260-0731-00			1					1 SWITCH, lever—WHITE REF
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-14	366-0215-02			1					1 KNOB, gray—BARS
-15	260-0621-00			1					1 SWITCH, lever—BARS
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting
-16	366-0215-02			1					1 KNOB, gray—VIDEO
-17	260-0621-00			1					1 SWITCH, lever—VIDEO
	- - - - -			-					mounting hardware: (not included w/switch)
	220-0413-00			2					2 NUT, switch mounting

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q † y						Description
					1	2	3	4	5	
1-18	366-0215-02			1						KNOB, gray—0° SUBCARRIER
-19	260-0731-00			1						SWITCH, lever—0° SUBCARRIER
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-20	366-0215-02			1						KNOB, gray—STEPS
-21	260-0664-00			1						SWITCH, lever—STEPS
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-22	366-0215-02			1						KNOB, gray—90° SUBCARRIER
-23	260-0621-00			1						SWITCH, lever—90° SUBCARRIER
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-24	366-0215-02			1						KNOB, gray—FIELD
-25	260-0621-00			1						SWITCH, lever—FIELD
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-26	366-0215-02			1						KNOB, gray—SIGNAL
-27	260-0621-00			1						SWITCH, lever—SIGNAL
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-28	366-0215-02			1						KNOB, gray—CROSSHATCH
-29	260-0621-00			1						SWITCH, lever—CROSSHATCH
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-30	366-0215-02			1						KNOB, gray—DISPLAY
-31	260-0621-00			1						SWITCH, lever—DISPLAY
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-32	366-0215-02			1						KNOB, gray—R-Y PHASE
-33	260-0621-00			1						SWITCH, lever—R-Y PHASE
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-34	366-0215-02			1						KNOB, gray—BURST
-35	260-0731-00			1						SWITCH, lever—BURST
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-36	366-0215-02			1						KNOB, gray—SYNC
-37	260-0731-00			1						SWITCH, lever—SYNC
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q t y						Description
					1	2	3	4	5	
1-38	366-0215-02			1						KNOB, gray—REF
-39	260-0731-00			1						SWITCH, lever—REF
	- - - - -			-						mounting hardware: (not included w/switch)
	220-0413-00			2						NUT, switch mounting
-40	366-0500-00			1						KNOB, gray—APL
	- - - - -			-						knob includes:
	213-0153-00			2						SETSCREW, 5-40 x 0.125 inch, HSS
-41	260-1088-00			1						SWITCH, unwired—APL
	- - - - -			-						mounting hardware: (not included w/switch)
	210-0978-00			1						WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch, OD
-42	210-0590-00			1						NUT, hex., $\frac{3}{8}$ -32 x $\frac{7}{16}$ inch
-43	366-0500-00			1						KNOB, gray—LINE
	- - - - -			-						knob includes:
	213-0153-00			2						SETSCREW, 5-40 x 0.125 inch, HSS
-44	260-1087-00			1						SWITCH, unwired—LINE
	- - - - -			-						mounting hardware: (not included w/switch)
	210-0978-00			1						WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch, OD
-45	210-0590-00			1						NUT, hex., $\frac{3}{8}$ -32 x $\frac{7}{16}$ inch
-46	366-1026-00			1						KNOB, gray—VERT POSITION
	- - - - -			-						knob includes:
	213-0153-00			2						SETSCREW, 5-40 x 0.125 inch, HSS
-47	- - - - -			1						RESISTOR, variable
	- - - - -			-						mounting hardware: (not included w/resistor)
	210-0978-00			1						WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch, OD
-48	210-0590-00			1						NUT, hex., $\frac{3}{8}$ -32 x $\frac{7}{16}$ inch
-49	366-1026-00			1						KNOB, gray—HORIZ POSITION
	- - - - -			-						knob includes:
	213-0153-00			2						SETSCREW, 5-40 x 0.125 inch, HSS
-50	- - - - -			1						RESISTOR, variable
	- - - - -			-						mounting hardware: (not included w/resistor)
	210-0978-00			1						WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch, OD
-51	210-0590-00			1						NUT, hex., $\frac{3}{8}$ -32 x $\frac{7}{16}$ inch
-52	366-0498-00			1						KNOB, gray—SUBCARRIER PHASE
	- - - - -			-						knob includes:
	213-0153-00			2						SETSCREW, 5-40 x 0.125 inch, HSS
-53	- - - - -			1						GONIOMETER
	- - - - -			-						goniometer includes:
-54	210-0048-00			1						WASHER, lock, internal, $\frac{5}{16}$ ID x 0.425 inch OD
-55	210-1025-00			1						WASHER, flat, 0.312 ID x 0.474 inch OD
	220-0576-00			1						NUT, hex., 0.375-32 x 0.437 inch
	210-0894-00			1						WASHER, plastic, 0.190 ID x $\frac{7}{16}$ inch OD
-56	210-1106-00			1						WASHER, spring tension, 0.205 ID x 0.50 inch OD

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q t y						Description
					1	2	3	4	5	
1-57	260-0276-00			1						SWITCH, toggle—POWER
	- - - - -			-						mounting hardware: (not included w/switch)
-58	210-0414-00			1						NUT, hex., $\frac{15}{32}$ -32 x $\frac{9}{16}$ inch
-59	337-1155-00			1						SHIELD, switch
-60	354-0055-00			1						RING, locking
	210-0902-00			1						WASHER, flat, 0.470 ID x $\frac{21}{32}$ inch OD
-61	210-0473-00			1						NUT, 12 sided, $\frac{15}{32}$ -32 x 0.634 inch
-62	333-1227-00 ¹			1						PANEL, front
-63	333-1228-00 ²			1						PANEL, front
-64	367-0102-00 ¹			2						HANDLE, carrying
	- - - - -			-						mounting hardware for each: (not included w/handle)
-65	212-0004-00 ¹			2						SCREW, 8-32 x $\frac{5}{16}$ inch, PHS
-66	213-0216-00 ¹			4						THUMBSCREW, 10-32 x 0.375 inch
-67	210-0894-00 ¹			4						WASHER, plastic
-68	354-0025-00 ¹			4						RING, retaining
-69	407-0510-00 ¹			2						BRACKET, angle
	- - - - -			-						mounting hardware for each: (not included w/bracket)
-70	212-0004-00 ¹			2						SCREW, 8-32 x $\frac{5}{16}$ inch, PHS
-71	124-0216-00 ²			2						STRIP, trim, plastic
	- - - - -			-						mounting hardware for each: (not included w/strip)
	212-0068-00 ²			2						SCREW, 8-32 x $\frac{5}{16}$ inch, THS
-72	136-0164-00			1						SOCKET, light
	- - - - -			-						mounting hardware: (not included w/socket)
-73	210-0413-00			1						NUT, hex., $\frac{3}{8}$ -32 x $\frac{1}{2}$ inch
	210-0012-00			1						WASHER, lock, internal, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch OD
	210-0978-00			1						WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch OD
-74	220-0480-02			1						NUT, plain, 0.377-32 x 0.438 inch
-75	136-0079-00			1						SOCKET ASSEMBLY, w/green jewel & hardware
-76	131-0126-00			5						CONNECTOR, coaxial, 1 contact, BNC, female, w/hardware
	- - - - -			-						mounting hardware for each: (not included w/connector)
-77	210-0241-00			1						LUG, terminal
-78	386-1605-00			1						SUBPANEL, front
-79	348-0048-00 ²			4						FOOT, rubber
-80	390-0065-00			1						CABINET SIDE, right
	- - - - -			-						mounting hardware: (not included w/cabinet side)
-81	211-0538-00			10						SCREW, 6-32 x $\frac{5}{16}$ inch, 100° csk, FHS
	210-0457-00			10						NUT, keps, 6-32 x $\frac{5}{16}$ inch
-82	390-0066-00			1						CABINET SIDE, left
	- - - - -			-						mounting hardware: (not included w/cabinet side)
-83	211-0538-00			10						SCREW, 6-32 x $\frac{5}{16}$ inch, 100° csk, FHS
	210-0457-00			10						NUT, keps, 6-32 x $\frac{5}{16}$ inch

¹Type R140 only²Type 140 only

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q t y					Description
				1	2	3	4	5	
1-84	351-0104-00 ³			pr					SLIDE, section
	- - - - -			-					mounting hardware for each: (not included w/slide)
-85	212-0004-00 ³			2					SCREW, 8-32 x 5/16 inch, PHS
-86	390-0112-00			1					CABINET TOP
	- - - - -			-					cabinet top includes:
-87	355-0134-00			2					STUD, turnlock fastener, FHS
-88	355-0135-00			12					STUD, turnlock fastener, OHS
-89	214-0389-00			14					FASTENER, retainer
-90	390-0063-00			1					CABINET BOTTOM
	- - - - -			-					cabinet bottom includes:
-91	355-0134-00			2					STUD, turnlock fastener, FHS
-92	355-0135-00			12					STUD, turnlock fastener, OHS
-93	214-0389-00			14					FASTENER, retainer
-94	386-1663-00 ⁴			1					PLATE, handle mounting
	- - - - -			-					plate includes:
-95	344-0098-00			2					CLIP
-96	367-0037-00			1					HANDLE
	- - - - -			-					mounting hardware: (not included w/handle)
-97	212-0506-00			2					SCREW, 10-32 x 3/8 inch, 100° csk, FHS
	- - - - -			-					mounting hardware: (not included w/plate)
	212-0507-00			2					SCREW, 10-32 x 0.375 inch, PHS

³Type R140 only⁴Type 140 only

FIGURE 2 CHASSIS & REAR

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q t y						Description
					1	2	3	4	5	
2-1	441-0824-01			1						CHASSIS, main
-2	344-0133-00			30						CLIP, circuit board
	- - - - -			-						mounting hardware for each: (not included w/clip)
-3	213-0138-00			1						SCREW, sheet metal, #4 x 3/16 inch, PHS
-4	670-0307-00			1						ASSEMBLY, circuit board—CROSS HATCH
	- - - - -			-						assembly includes:
	388-1324-00			1						BOARD, circuit
-5	131-0589-00			26						TERMINAL, pin, 0.50 inch long
-6	131-0633-00			4						TERMINAL, pin, 0.385 inch long
-7	136-0183-00			1						SOCKET, transistor, 3 pin
-8	136-0220-00			25						SOCKET, transistor, 3 pin, square
-9	136-0237-00			19						SOCKET, semiconductor, 8 pin
-10	214-0579-00			16						PIN, test point
	- - - - -			-						mounting hardware: (not included w/assembly)
-11	211-0116-00			4						SCREW, sems, 4-40 x 5/16 inch, PHB
-12	670-0308-00			1						ASSEMBLY, circuit board—OUTPUT AMPS
	- - - - -			-						assembly includes:
	388-1325-00			1						BOARD, circuit
-13	131-0589-00			23						TERMINAL, pin, 0.50 inch long
-14	136-0220-00			33						SOCKET, transistor, 3 pin, square
-15	214-0579-00			7						PIN, test point
	- - - - -			-						mounting hardware: (not included w/assembly)
-16	211-0116-00			4						SCREW, sems, 4-40 x 5/16 inch, PHB
-17	670-0324-00			1						ASSEMBLY, circuit board—POWER SUPPLY
	- - - - -			-						assembly includes:
	388-1467-00			1						BOARD, circuit
-18	131-0589-00			39						TERMINAL, pin, 0.50 inch long
-19	136-0183-00			3						SOCKET, transistor, 3 pin
-20	136-0220-00			10						SOCKET, transistor, 3 pin, square
-21	214-0579-00			4						PIN, test point
	- - - - -			-						mounting hardware: (not included w/assembly)
-22	211-0116-00			3						SCREW, sems, 4-40 x 3/16 inch, PHB
-23	343-0088-00			2						CLAMP, cable, plastic, small
-24	343-0089-00			1						CLAMP, cable, plastic, large
-25	255-0334-00			ft						CHANNEL, plastic, 3 lengths of 3 3/4 inches each
-26	214-1169-00			12						PIN, guide
	- - - - -			-						mounting hardware for each: (not included w/pin)
-27	210-0457-00			1						NUT, keps, 6-32 x 5/16 inch
-28	210-0201-00			6						LUG, solder, SE #4
	- - - - -			-						mounting hardware for each: (not included w/lug)
-29	213-0044-00			1						SCREW, thread forming, 5-32 x 3/16 inch, PHS

FIGURE 2 CHASSIS & REAR (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q † y	1	2	3	4	5	Description
2-30	348-0050-00			4						GROMMET, plastic, 3/4 inch diameter
-31	348-0063-00			2						GROMMET, plastic, 1/2 inch diameter
-32	348-0064-00			1						GROMMET, plastic, 5/8 inch diameter
-33	670-0301-00			1						ASSEMBLY, circuit board—MODULATOR
	- - - - -			-						assembly includes:
	388-1318-00			1						BOARD, circuit
-34	131-0589-00			29						TERMINAL, pin 0.50 inch long
-35	136-0220-00			22						SOCKET, transistor, 3 pin, square
-36	136-0235-00			2						SOCKET, semiconductor, 6 pin
-37	136-0237-00			1						SOCKET, semiconductor, 8 pin
-38	214-0506-00			4						PIN, connector
-39	214-0579-00			10						PIN, test point
-40	352-0134-00			4						HOLDER, toroid
-41	670-0302-00			1						ASSEMBLY, circuit board—BAR TIMING
	- - - - -			-						assembly includes:
	388-1319-00			1						BOARD, circuit
-42	131-0589-00			49						TERMINAL, pin, 0.50 inch long
-43	136-0220-00			22						SOCKET, transistor, 3 pin, square
-44	136-0237-00			20						SOCKET, semiconductor, 8 pin
-45	214-0579-00			6						PIN, test point
-46	670-0303-00			1						ASSEMBLY, circuit board—FIELD TIMING
	- - - - -			-						assembly includes:
	388-1320-00			1						BOARD, circuit
-47	131-0589-00			54						TERMINAL, pin, 0.50 inch long
-48	136-0220-00			16						SOCKET, transistor, 3 pin, square
-49	136-0237-00			37						SOCKET, semiconductor, 8 pin
-50	214-0579-00			11						PIN, test point
-51	386-1532-00			1						SUPPORT, chassis
-52	386-1487-00			1						SUPPORT, bracket
-53	670-0304-00			1						ASSEMBLY, circuit board—BAR DRIVE/VIDEO OUT
	- - - - -			-						assembly includes:
	388-1321-00			1						BOARD, circuit
-54	131-0589-00			43						TERMINAL, pin, 0.50 inch long
-55	136-0183-00			2						SOCKET, transistor, 3 pin
-56	136-0220-00			44						SOCKET, transistor, 3 pin, square
-57	136-0337-00			1						SOCKET, relay, 8 pin
-58	670-0305-00			1						ASSEMBLY, circuit board—STAIRCASE
	- - - - -			-						assembly includes:
	388-1322-00			1						BOARD, circuit
-59	131-0589-00			20						TERMINAL, pin, 0.50 inch long
-60	136-0220-00			25						SOCKET, transistor, 3 pin, square
-61	136-0237-00			11						SOCKET, semiconductor, 8 pin
-62	214-0579-00			6						PIN, test point

FIGURE 2 CHASSIS & REAR (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q					Description
				t	y	1	2	3	
2-63	670-0306-00			1					ASSEMBLY, circuit board—LINE TIMING
	- - - - -			-					assembly includes:
	388-1323-00			1					BOARD, circuit
-64	131-0589-00			35					TERMINAL, pin, 0.50 inch long
-65	136-0220-00			34					SOCKET, transistor, 3 pin, square
-66	136-0234-00			2					RECEPTACLE, electrical
-67	136-0235-00			1					SOCKET, semiconductor, 6 pin
-68	136-0237-00			23					SOCKET, semiconductor, 8 pin
-69	214-0579-00			23					PIN, test point
-70	352-0096-00			1					HOLDER, crystal
-71	- - - - -			1					TRANSFORMER
	- - - - -			-					mounting hardware: (not included w/transformer)
-72	212-0516-00			4					SCREW, 10-32 x 2 inches, HHS
	210-0812-00			4					WASHER, fiber, #10
	166-0227-00			4					TUBE, insulating, plastic (not shown)
-73	220-0410-00			4					NUT, keps, 10-32 x 3/8 inch
-74	407-0556-00			1					BRACKET, capacitor
	- - - - -			-					mounting hardware: (not included w/bracket)
-75	211-0507-00			4					SCREW, 6-32 x 5/16 inch, PHS
-76	210-0457-00			4					NUT, keps, 6-32 x 5/16 inch
-77	407-0555-00			1					BRACKET, transformer
	- - - - -			-					mounting hardware: (not included w/bracket)
	210-0457-00			4					NUT, keps, 6-32 x 5/16 inch
-78	211-0507-00			4					SCREW, 6-32 x 5/16 inch, PHS
-79	200-0293-00			1					COVER, capacitor, plastic, 1.365 ID x 2 9/16 inches long
-80	200-0538-00			1					COVER, capacitor, plastic, 1.365 ID x 1.644 inches long
-81	- - - - -			2					CAPACITOR
	- - - - -			-					mounting hardware for each: (not included w/capacitor)
-82	211-0588-00			2					SCREW, 6-32 x 3/4 inch, HHS
-83	432-0048-00			1					BASE, capacitor mounting
-84	386-0254-00			1					PLATE, fiber, large
-85	210-0457-00			2					NUT, keps, 6-32 x 5/16 inch
-86	441-0892-00			1					CHASSIS
	- - - - -			-					mounting hardware: (not included w/chassis)
-87	211-0504-00			2					SCREW, 6-32 x 0.250 inch, PHS
-88	210-0457-00			2					NUT, keps, 6-32 x 5/16 inch

FIGURE 2 CHASSIS & REAR (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q					Description
				y	1	2	3	4	
2-	119-0210-00			1					ASSEMBLY, oven
	- - - - -			-					assembly includes:
-89	200-0906-01			1					COVER, oven assembly
-90	214-1097-01			1					INSULATOR, oven, thermal
-91	200-0769-00			1					COVER, oven, inner
-92	348-0126-00			1					PAD, cushioning
-93	670-0310-00			1					ASSEMBLY, circuit board—S. C. OSC
	- - - - -			-					assembly includes:
	388-1327-00			1					BOARD, circuit
-94	131-0633-00			3					TERMINAL, pin, 0.385 inch long
-95	136-0220-00			3					SOCKET, transistor, 3 pin, square
-96	136-0234-00			2					RECEPTACLE, electrical
-97	136-0235-00			1					SOCKET, semiconductor, 6 pin
-98	205-0108-01			1					SHELL, oven
-99	214-1096-00			1					INSULATOR, oven, thermal
-100	670-0309-00			1					ASSEMBLY, circuit board—SUBCARRIER OUTPUT
	- - - - -			-					assembly includes:
	388-1326-00			1					BOARD, circuit
-101	131-0589-00			20					TERMINAL, pin, 0.50 inch long
-102	136-0183-00			1					SOCKET, transistor, 3 pin
-103	136-0220-00			8					SOCKET, transistor, 3 pin, square
-104	214-0579-00			1					PIN, test point
	210-1002-00			2					WASHER, flat, 0.125 ID x 0.250 inch OD
-105	210-0586-00			2					NUT, keps, 4-40 x 1/4 inch
	- - - - -			-					mounting hardware: (not included w/assembly)
-106	211-0116-00			2					SCREW, sems, 4-40 x 5/16 inch, PHB
-107	386-1606-00			1					PANEL, rear
-108	- - - - -			1					LINE FILTER
	- - - - -			-					mounting hardware: (not included w/line filter)
	210-0457-00			2					NUT, keps, 6-32 x 5/16 inch
-109	211-0507-00			2					SCREW, 6-32 x 5/16 inch, PHS
-110	204-0279-00			1					BODY, line voltage selector
	- - - - -			-					mounting hardware: (not included w/body)
	210-0006-00			2					WASHER, lock, internal, #6
-111	210-0407-00			2					NUT, hex., 6-32 x 1/4 inch
-112	200-0762-00			1					COVER, line voltage selector
	- - - - -			-					cover includes:
-113	352-0102-00			2					HOLDER, fuse, plastic
	- - - - -			-					mounting hardware for each: (not included w/holder)
-114	213-0088-00			2					SCREW, thread forming, #4 x 1/4 inch, PHS
-115	200-0918-01			1					COVER, transistor
	- - - - -			-					mounting hardware: (not included w/cover)
-116	211-0008-00			4					SCREW, 4-40 x 1/4 inch, PHS

FIGURE 2 CHASSIS & REAR (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q † y						Description
					1	2	3	4	5	
2-117	- - - - -			2						TRANSISTOR
	- - - - -			-						mounting hardware for each: (not included w/transistor)
-118	211-0510-00			2						SCREW, 6-32 x 3/8 inch, PHS
-119	386-0978-00			1						PLATE, insulator
	210-0975-00			2						WASHER, plastic, shouldered, 0.140 ID x 0.375 inch OD
	210-0803-00			2						WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1						LUG, solder, SE #6
-120	210-0457-00			2						NUT, keps, 6-32 x 5/16 inch
-121	- - - - -			1						TRANSISTOR
	- - - - -			-						mounting hardware: (not included w/transistor)
-122	211-0510-00			2						SCREW, 6-32 x 3/8 inch, PHS
-123	386-0143-00			1						PLATE, insulator
	210-0935-00			2						WASHER, fiber, shouldered, 0.140 ID x 0.375 inch OD
	210-0803-00			2						WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1						LUG, solder, SE #6
-124	210-0457-00			2						NUT, keps, 6-32 x 5/16 inch
-125	131-0126-00			18						CONNECTOR, coaxial, 1 contact, BNC, female, w/hardware
	- - - - -			-						mounting hardware for each: (not included w/connector)
-126	210-0241-00			1						LUG, terminal
-127	344-0118-00			2						CLIP, capacitor mounting
	- - - - -			-						mounting hardware for each: (not included w/clip)
	211-0504-00			1						SCREW, 6-32 x 1/4 inch, PHS
-128	179-1397-00	B010100	B039999	1						WIRING HARNESS, chassis
	179-1397-01	B040000		1						WIRING HARNESS, chassis
	- - - - -			-						wiring harness includes:
-129	131-0621-00			219						CONNECTOR, terminal
	131-0622-00			14						CONNECTOR, terminal
	131-0792-00			4						CONNECTOR, terminal
-130	352-0198-00			2						HOLDER, terminal connector, 2 wire
-131	352-0199-00			3						HOLDER, terminal connector, 3 wire
-132	352-0200-00			4						HOLDER, terminal connector, 4 wire
-133	352-0201-00			5						HOLDER, terminal connector, 5 wire
-134	352-0202-00			1						HOLDER, terminal connector, 6 wire
-135	352-0203-00	B010100	B010142	6						HOLDER, terminal connector, 7 wire
	352-0203-00	B010143		7						HOLDER, terminal connector, 7 wire
-136	352-0204-00			7						HOLDER, terminal connector, 8 wire
-137	352-0205-00			3						HOLDER, terminal connector, 9 wire
-138	352-0206-00	B010100	B010142	15						HOLDER, terminal connector, 10 wire
	352-0206-00	B010143		14						HOLDER, terminal connector, 10 wire
-139	179-1398-00			1						WIRING HARNESS, power
	- - - - -			-						wiring harness includes:
-140	131-0621-00			21						CONNECTOR, terminal
-141	352-0203-00			1						HOLDER, terminal connector, 7 wire
-142	352-0205-00			9						HOLDER, terminal connector, 9 wire
-143	179-1399-00			1						WIRING HARNESS, line voltage selector
-144	179-1400-00			1						WIRING HARNESS, coaxial
	- - - - -			-						wiring harness includes:
-145	131-0621-00			19						CONNECTOR, terminal
	131-0622-00			19						CONNECTOR, terminal
-146	352-0198-00	B010100	B010142	2						HOLDER, terminal connector, 2 wire
	352-0198-00	B010143		1						HOLDER, terminal connector, 2 wire
-147	352-0200-00			2						HOLDER, terminal connector, 4 wire
-148	352-0206-00			2						HOLDER, terminal connector, 10 wire
-149	352-0201-00	XB010143		1						HOLDER, terminal connector, 5 wire

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

TEXT CORRECTION

Section 2 Operating Instructions

Page 2-15 & 2-16 Procedure 3, step 6

CHANGE: to read:

6. Change the COLOR BAR R-Y lever switch on the Type R140 to the down position. The display should consist of the burst vector and 6 dots on the B-Y (or 0° - 180°) axis. See Fig. 2-14(A). This display contains only the B-Y component of the color bar.

Return the R-Y lever switch to the up position.

Page 2-16 Procedure 3, step 7

CHANGE: the second paragraph to read:

The display should now be a vertical row of 6 dots on the R-Y (90° - 270°) axis plus the burst vector at 180° . See Fig. 2-14(B). This display contains the R-Y component of the color bar.

Return the B-Y lever switch to the up position.

Page 2-16 Procedure 3, Step 8

CHANGE: the 1st paragraph to read:

8. All color vectors should fall within thier respective inner boxes on the graticule (indicating that they are within $\pm 2.5^\circ$ phase and ± 2.5 IRE units amplitude error limits) when both R-Y and B-Y components are present in the color bar signal. See Fig. 2-13.

Page 2-16 Step 11

ADD: after the last sentence:

See Fig. 2-17(A).

ADD: a new Fig. 2-17:

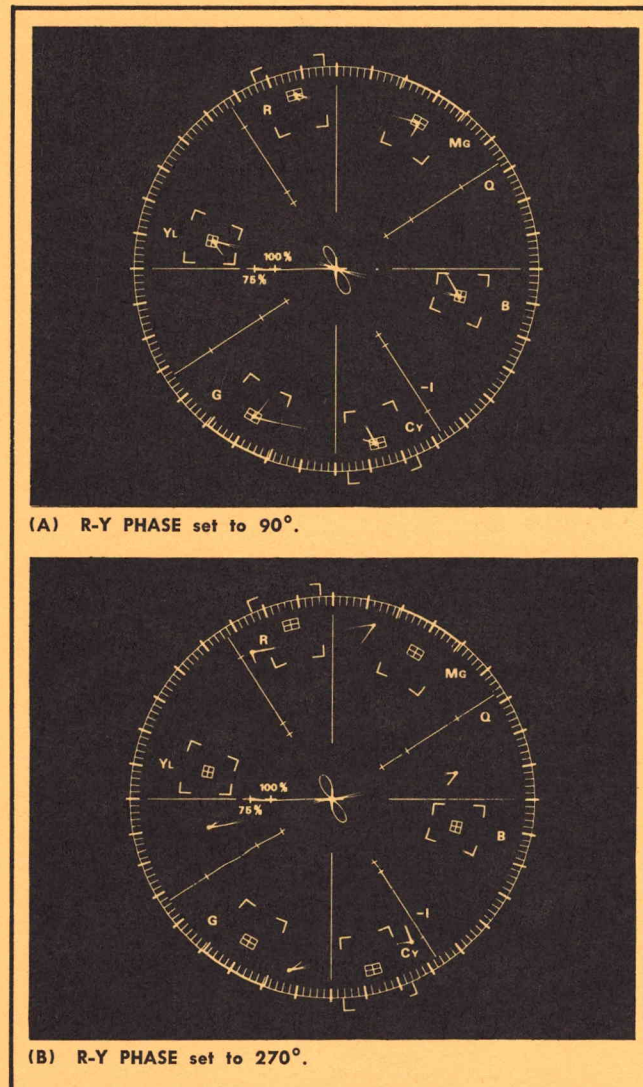


Fig. 2-17. Vector display of color bar signal with R-Y PHASE set to 90° or 270° .

Page 2-16 Fig. 2-13

CHANGE: last line in caption to read:

...color vectors are within $\pm 2.5^{\circ}$ phase and ± 2.5 IRE units amplitude limits.

Section 4 Maintenance

Page 4-4 Fig. 4-2

CHANGE: caption to read:

Fig. 4-2. Removal and replacement of interconnecting wires and plastic holders.

Section 5 Performance Check/Calibration

Page 5-1 Equipment List

CHANGE: item 9 to read:

9. 011-0100-01 Voltage Step Up Termination. Tektronix Part No. 011-0100-01.

Page 5-3 Short Form Calibration Procedure

CHANGE: step 15 to read:

15. Check/Adjust Modulator Quadrature Phasing page 5-22
Requirement: Chrominance bars must overlay within 10 mV (using
the Voltage Step Up Termination).

Page 5-22 Step 15 b

CHANGE: parts b and e to read:

b. CHECK--Test oscilloscope display; displays must overlay within
10 mV. (Typically 8 mV.)

e. ADJUST--L126 (see Fig. 5-14) for best color bar overlay; must
be within 10 mV. (See Fig. 5-17B for improper display.)

Page 5-43 Step 36

CHANGE: part b to read:

b. Set the Type R140 COLOR BAR R-Y and B-Y switches down, VIDEO switch
up, and the MOD STAIRCASE STEPS switch up.

Page 5-43

Fig. 5-41

REPLACE: the existing Figure with the one below:

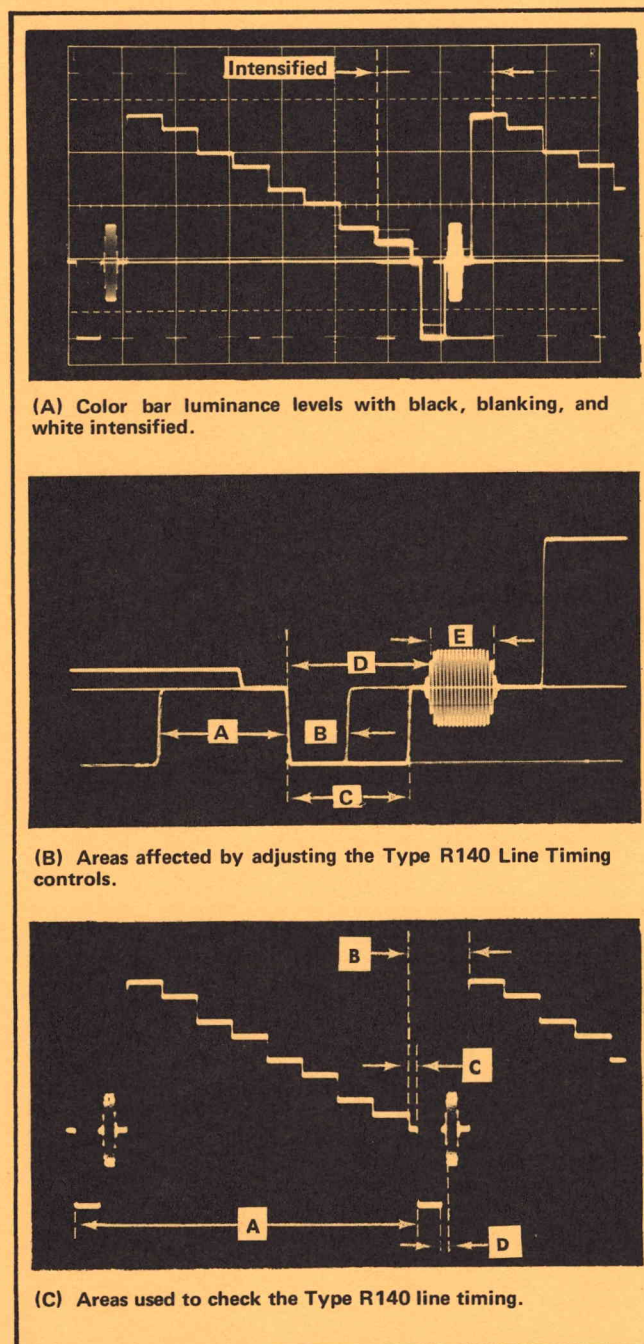


Fig. 5-41. Typical displays used to check or adjust line timing.

C3/270

Page 5-54 Step 43

CHANGE: the first line of part o to read:

o. Disconnect the 015-0149-00 calibration fixture Un- ...

CHANGE: the first line of part q to read:

q. Disconnect the 015-0149-00 calibration fixture Un- ...

Page 5-56 Step 45

CHANGE: part r to read:

r. Rotate the Type R520 Vectorscope Calibrated Phase control to again null the first step.

Page 5-57 Step 45

CHANGE: part w to read:

w. CHECK--Diff Phase resultant noted in Part v must be less than 0.1° .

TEXT CORRECTION

Section 1 Specification

Page 1-3 TABLE 1-1, Subcarrier Component

CHANGE: Unmod to read: "30 mV within 5 mV..."

CHANGE: Modulated Subcarrier to read: "30 mV within 5 mV...", and "Incidental phase errors between 305 mV and 610 mV signals, 0.5° or less."

Page 1-3 TABLE 1-2

CHANGE: Comp Video Isolation to read as follows:

COMP VIDEO

Isolation

Passive

Either open or short of one output shall cause an output level change at the other connector of less than 1%, i. e. 40 dB for all components of the signal.

Active (Non-Coherent Crosstalk)

A signal introduced to one output connector will be attenuated by at least 40 dB at the other connector for signals between +0.5 and -4.0 volts at or below color subcarrier frequency.

Page 1-4 TABLE 1-2

CHANGE: Luminance and Chrominance Accuracy to read: "...1% or residual subcarrier plus 1 mV,..."

Page 1-5 TABLE 1-3

CHANGE: COMP SYNC Isolation to read:

COMP SYNC

Isolation

Passive

Either open or short of one putput shall cause on output level change at the other connector of less than 1%, i. e. 40 dB for all components of the signal.

Active (Non-Coherent Crosstalk)

A signal introduced to one output connector will be attenuated by at least 34 dB at the other connector for signals between +3.0 and -0.5 volts, at or below color subcarrier frequency.

CHANGE: SUBCARRIER Isolation to read:

SUBCARRIER

Isolation

Passive

Either open or short of one output shall cause an output level change at the other connector of less than 1%; i. e. 40 dB for all components of the signal.

Active (Non-Coherent Crosstalk)

A signal introduced to one connector will be attenuated by at least 34 dB at the other connector for signals between +0.5 and -4.0 volts at or below color subcarrier frequency.

Page 1-6

CHANGE: COMP BLANKING Isolation to read:

COMP BLANKING

Isolation

Passive

Either open or short of one output shall cause an output level change at the other connector of less than 1%, i. e. 40 dB for all components of the signal.

Active (Non-Coherent Crosstalk)

A signal introduced to one output connector will be attenuated by at least 34 dB at the other connector for signals between +3.0 and -0.5 volts at or below color subcarrier frequency.

CHANGE: BURST Breezeway to read: "at least 500 ns."

CHANGE: BURST Envelope Duration to read: "2.22 μ s to 2.61 μ s; 8 cycle minimum."

DELETE: BURST "Time Duration....." "7.94 μ s....."

ADD: Delay from Horizontal Sync 5.55 μ s within 5%.

Page 1-6

TABLE 1-4

CHANGE: CONVERGENCE PATTERN Isolation to:

CONVERGENCE PATTERN Isolation

Passive

Either open or short of one output shall cause an output level change at the other connector of less than 1%, i. e. 40 dB for all components of the signal.

Active (Non-Coherent Crosstalk)

A signal introduced to one output connector will be attenuated by at least 40 dB at the other connector for signals between +0.5 and -4.0 volts at or below color subcarrier frequency.

ELECTRICAL PARTS LIST AND DIAGRAM CORRECTION

Section 7 Electrical Parts List

Page 7-1 CHASSIS, Capacitors

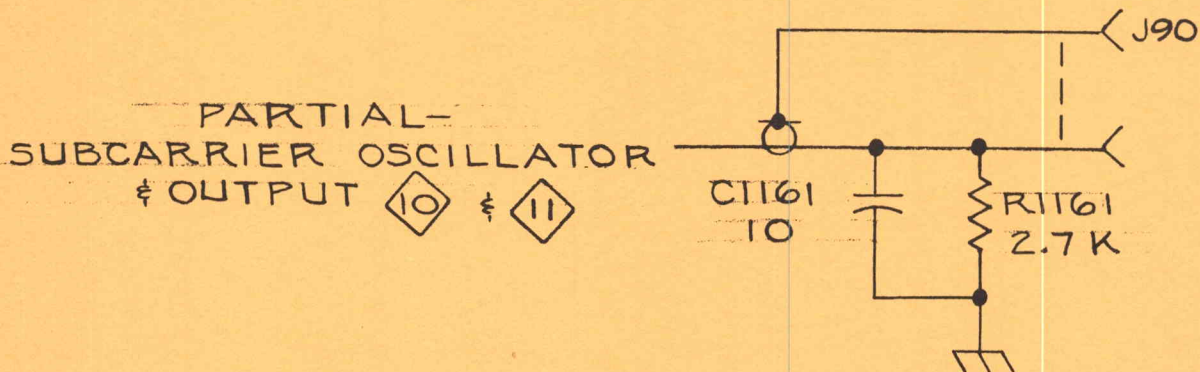
CHANGE: C1157 to C1161

Page 7-2 CHASSIS, Resistors

CHANGE: R1157 to R1161

Section 8 Diagrams

CHANGE: as follows:



TEXT CORRECTION

Section 1

Specification

Page 1-4

TABLE 1-4 CONVERGENCE PATTERN SIGNAL
ELECTRICAL CHARACTERISTICS

CHANGE: Pulse Amplitude to read:

77 IRE within 3 IRE

DELETE: Amplitude (overall)

1 volt peak to peak within 5%

TYPE 140/R140

TENT SN B070000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

CROSS HATCH

Circuit Board Assembly

CHANGE TO:

R787	321-0295-00	11.5 k Ω	1/8 W	MF	1%
R788	321-0388-00	107 k Ω	1/8 W	MF	1%

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

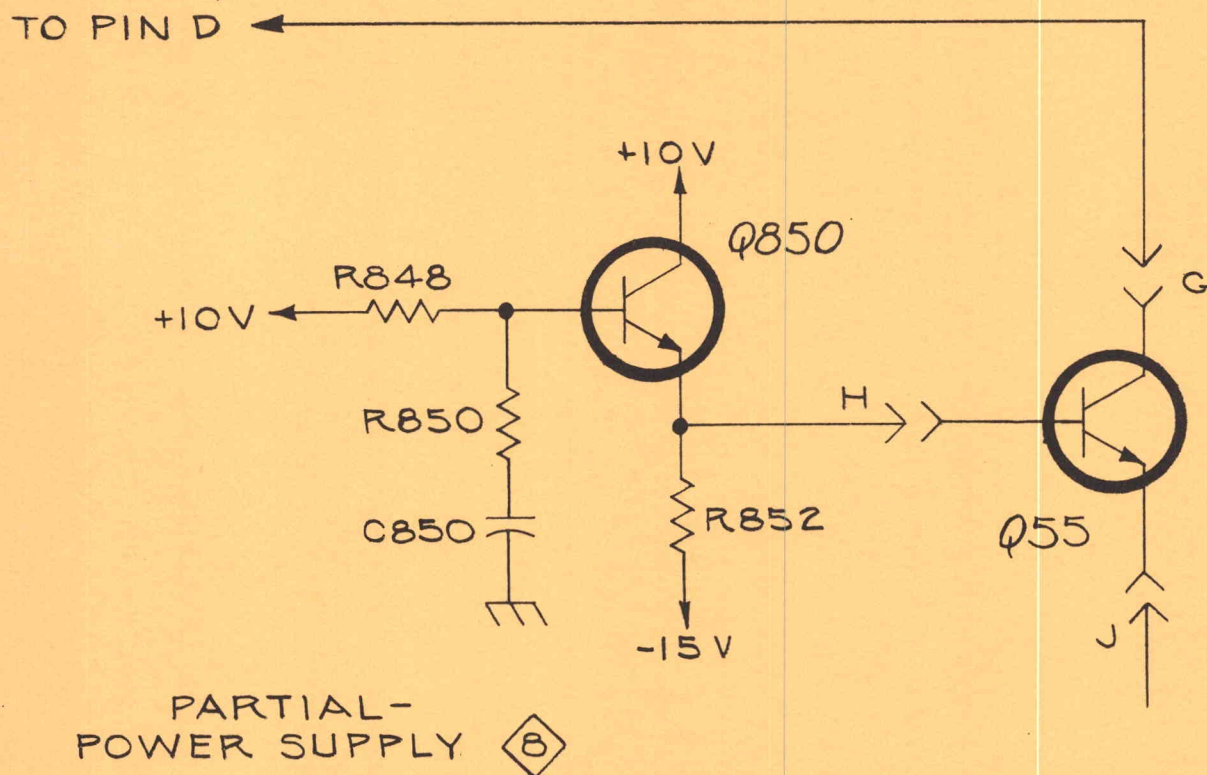
POWER SUPPLY

Circuit Board Assembly

CHANGE TO:

670-0324-01

Complete Board



ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

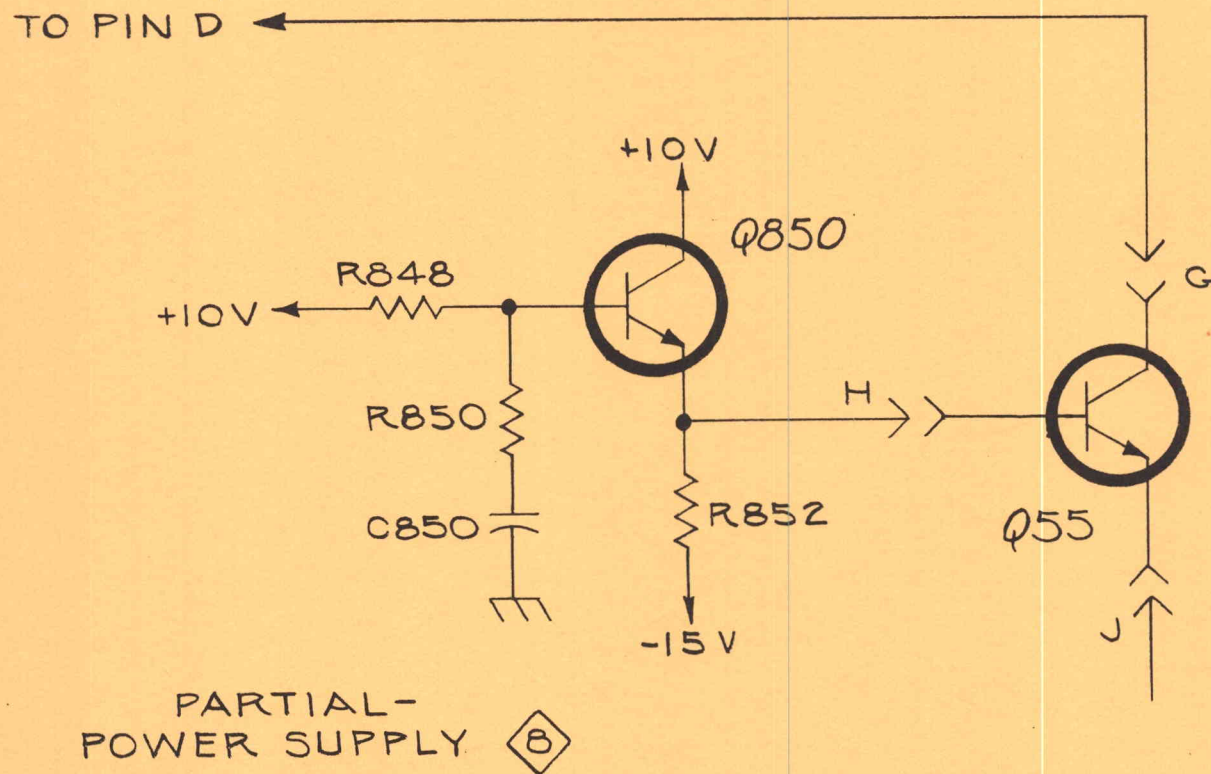
POWER SUPPLY

Circuit Board Assembly

CHANGE TO:

670-0324-01

Complete Board



140/R140

TENT SN B070000-up

ELECTRICAL PARTS LIST CORRECTION

CHASSIS

CHANGE TO:

FL4

119-0095-06

2 x 1 A, 250 VAC, 400 Hz

M16,801/1170

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

MODULATOR

Circuit Board Assembly

CHANGE TO:

C176	283-0642-00	33 pF	Mica	300 V		
C184	283-0633-00	77 pF	Mica	100 V		
R174	321-0193-00	1 k Ω	1/8 W	MF	Prec	1%

BAR DRIVE & VIDEO OUT

Circuit Board Assembly

CHANGE TO:

C496	290-0309-00	100 μ F	Elect.	25 V		
R404	321-0331-00	27.4 k Ω	1/8 W	MF	Prec	1%
R414	311-0840-00	20 k Ω , Var				
R463	311-0950-00	10 k Ω , Var				
R464	321-0349-00	42.2 k Ω	1/8 W	MF	Prec	1%
R481	321-0172-00	604 Ω	1/8 W	MF	Prec	1%
R473	321-0228-00	2.32 k Ω	1/8 W		Prec	1%

STAIRCASE

Circuit Board Assembly

CHANGE TO:

R557	321-0295-00	11.5 k Ω	1/8 W	MF	Prec	1%
R567	311-0953-00	2.5 k Ω , Var				

ADD:

C523	283-0028-00	0.0022 μ F	Cer	50 V		
C543	283-0028-00	0.0022 μ F	Cer	50 V		

LINE TIMING

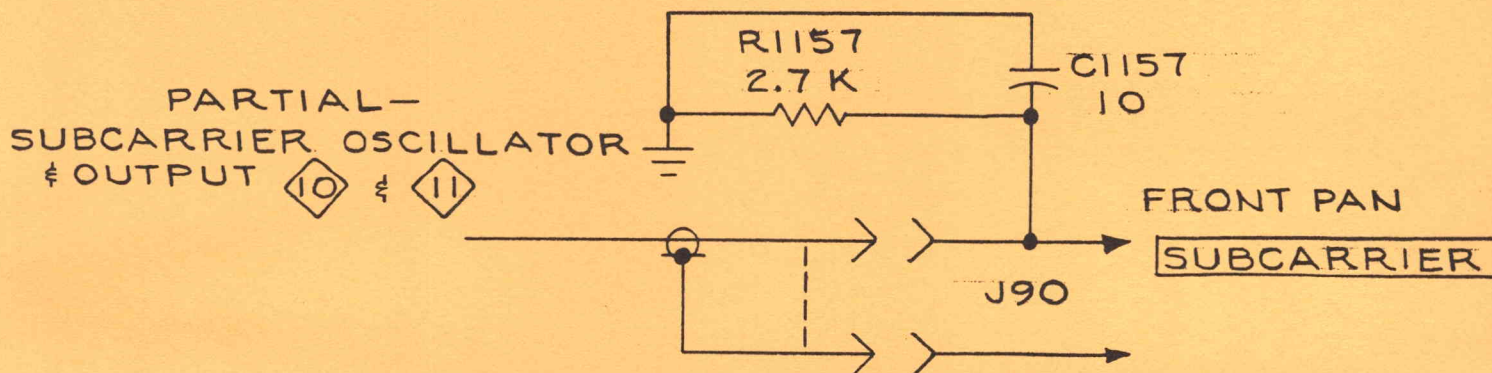
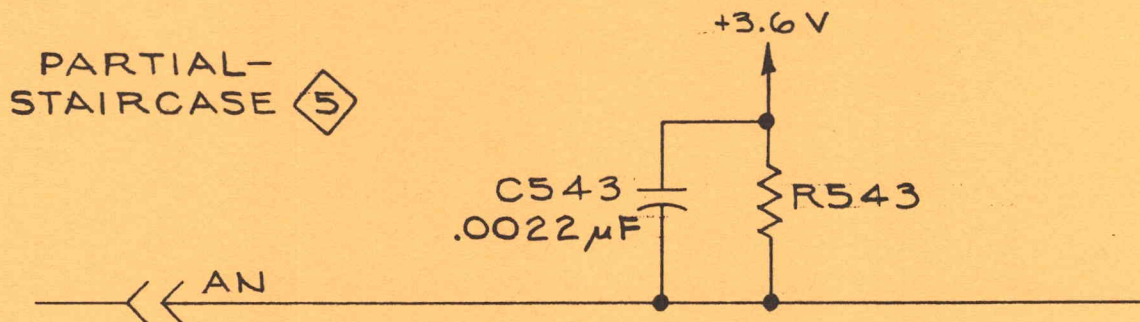
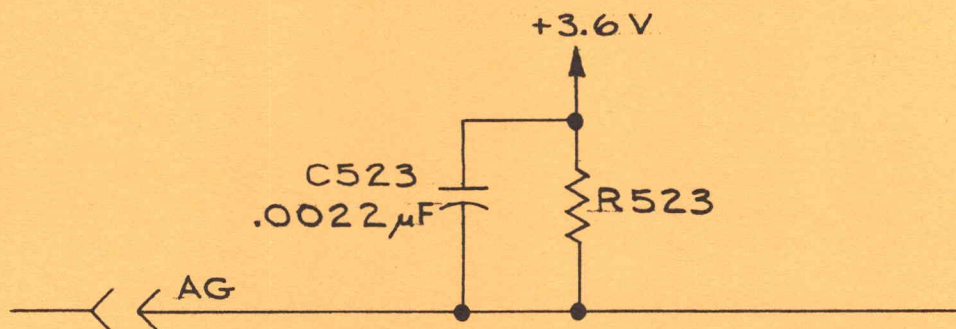
Circuit Board Assembly

CHANGE TO:

R6600	321-0249-00	3.83 k Ω	1/8 W	MF	Prec	1%
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ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS (cont)

SUBCARRIER OUTPUT		Circuit Board Assembly			
ADD:					
C1157	281-0613-00	10 pF	Cer	200 V	
R1157	315-0272-00	2.7 k Ω	1/4 W		5%



TYPE 140/R140

TENT SN B050710

ELECTRICAL PARTS LIST CORRECTION

LINE TIMING Circuit Board Assembly

CHANGE TO:

Q673

151-1041-00

FET

Dual

M16,079/770

TEXT AND SCHEMATIC CORRECTIONS

Section 4

Maintenance

Page 4-10

8. Check Individual Components

ADD: part G:

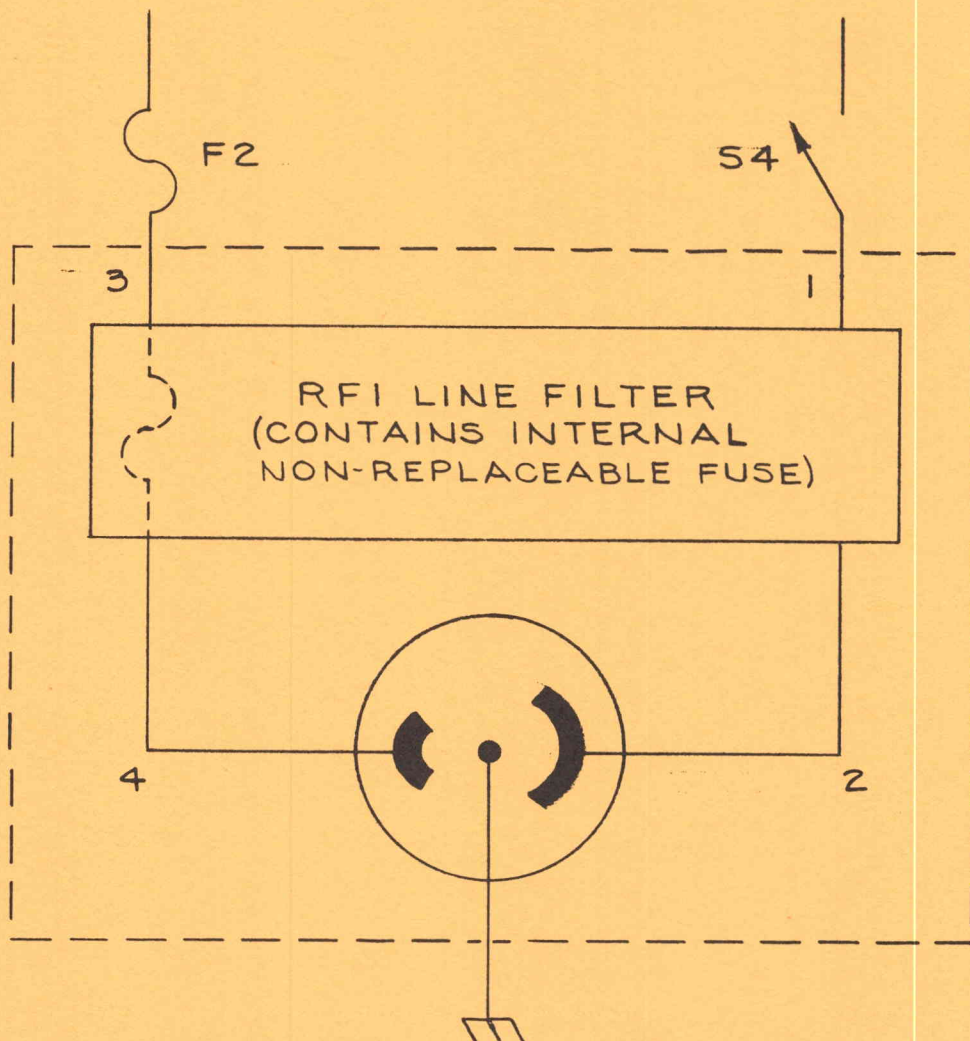
G. Power Input Connector and RFI Filter. This item is replaceable as a unit and repair should not be attempted. If it is necessary to replace this unit, be sure to observe polarity to assure protection for the instrument. The narrow blade (terminal 4) should show continuity to terminal 3 which connects to fuse F2. The filter contains an internal non-replaceable fuse between terminals 4 and 3. Use care when soldering to terminals 1 and 3, as excess solder could cause a short to the filter case.

Section 8

Power Supply

8

CHANGE: Power input circuitry as follows:



ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CROSS HATCH

Circuit Board Assembly

ADD:

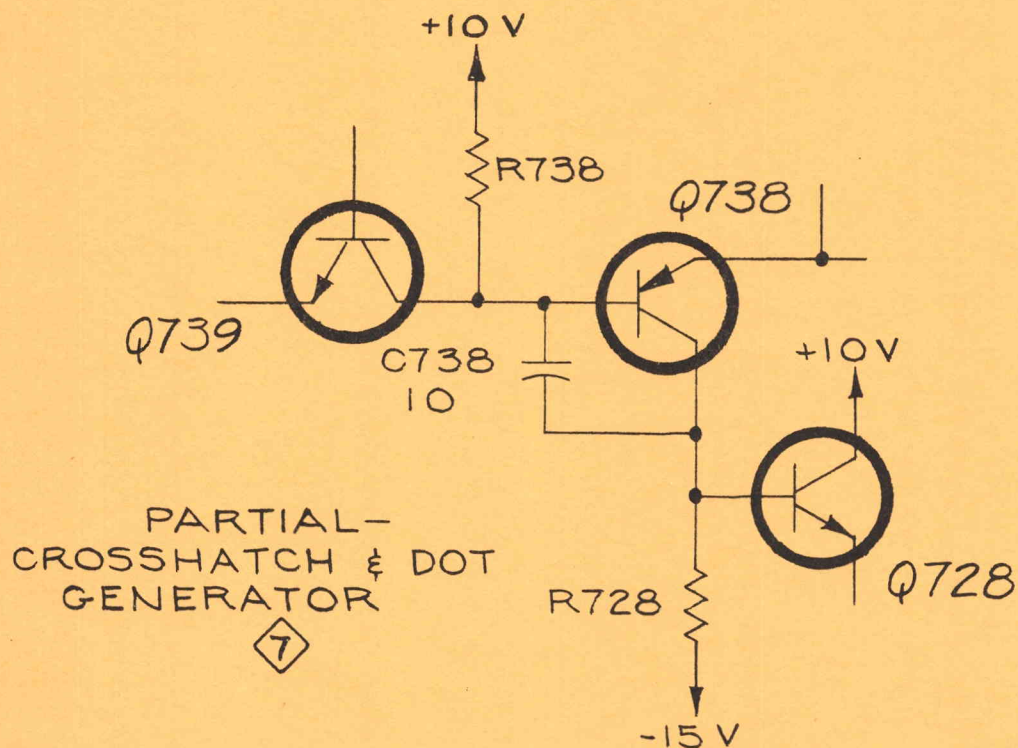
C738

281-0613-00

10 pF

Cer

200 V



140/R140 NTSC

144/R144 NTSC

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

LINE TIMING Circuit Board Assembly

CHANGE TO:

R6500	321-0252-00	4.12 k	1/8 W	1%
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